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IN
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MODERN TRENDS
IN
GERIATRICS

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INTRODUCTION

BETWEEN the two world wars British medicine was more concerned with the problems of the younger age groups than with those of the elderly There were few text-books of geriatrics and little in the way of modern trends to be talked about Geriatrics was a neglected subject because nobody thought that we could do very much to help the elderly, moreover the problem was of minor importance compared with, for example, the problems of child health

Since the end of the Second World War this emphasis has changed completely due to the control of many of the killing diseases of childhood and early adult life The late Lord Horder, who was to have written a foreword to this book, referred to this change in the following words "The problem of the care of the elderly person becomes not only more and more topical, it is of increasing urgency. Whether in sickness or in health the problem is formidable" This idea has been expressed even more strongly by Bernard Baruch, who, when asked to comment on the most significant events which had occurred in the first half of the present century replied that he considered the increase of the life span to have had more profound medical, economic, and social implications than such discoveries as atomic energy and air transport

When we come to study the problems of geriatric medicine we begin to realize the vast gaps there are in our knowledge Just as the very young present anatomical, physiological and pathological features peculiar to their age, so do the elderly Our standard text books on these subjects, however, have little to say about the normal variations which occur with age The very urgency of the problem has stimulated a vast amount of research and investigation on both sides of the Atlantic during the last ten years There are now several journals devoted solely to geriatrics and a number of books have appeared on special aspects of the subject No apology is required, therefore, for the appearance of a *Modern Trends in Geriatrics*

The task of selecting suitable subjects for inclusion has not been an easy one and has depended to a certain extent upon the availability of suitable authors I wish to express my gratitude to the publishers, Messrs Butterworths for all the help they have given me during the preparation of this book

I should have wished to include a chapter on the psychiatric problems of old age but for various reasons it was not possible to do this In any case they have been dealt with to a certain extent by the general physicians who have written on the home care and hospital care of the elderly

I hope that this book will be of practical value to all doctors in whatever sphere they may work Also I hope it will prove useful reading for all persons whose work is concerned with the care of the elderly

August, 1956 WILLIAM HOBSON

CHAPTER 1

GENERAL PROBLEMS OF AGEING

WILLIAM HOBSON

HISTORICAL

PHYSICIANS have been interested in the problems of ageing from the very earliest times The Chinese had much sound advice to give on rules for healthy living and considered that the physician's main duty was to instruct the healthy rather than to treat the ill They considered that evil customs caused premature ageing of the body and that one could escape old age by living the right way They noted that an excess of salt hardened the pulse Nor is the Old Testament without its hints on methods of preserving health in old age One theory was that as a person became older heat was exhausted and so David took a healthy virgin to lie on his body and keep him warm The Greeks also seemed to believe in this theory and Cohausen recommended the breath of a young virgin as a revitalizing influence Pythagoras recommended ' temperance and moderation in all things as a means to health and long life ' [illegible]
it was reall[illegible]
to the speci[illegible]
chief factors in living a long and healthy life and that a spare diet was one of the best ways of achieving longevity, this observation was confirmed recently in animal experiments He described the diseases and conditions to which old people are subject, such as cataract, dimness of vision glaucoma dullness of hearing de fluxions of the eyes nose and bowels, dyspnoea, dysuria, nephritis, catarrh, pains of the joints, vertigo, cachexia, apoplexy, generalized pruritus and what he called insomnelency" It thus would appear that things have not changed very much during the last 2 000 years

Literature

One of the earliest books devoted solely to the problems of old age was *De Senectute*, written in 44 B C by Cicero and was largely a repetition of the teachings of Pythagoras and Hippocrates Galen was the next great physician concerned with the problems of ageing He was born in A D 131 and died in A D 201 As the older physicians had suggested, he considered old age was caused by the wasting of innate heat This could be overcome by good food, wine, the taking of adequate exercise and massage Again, moderation in everything was advised The same advice was repeated by writers in the Arab schools of medicine, who again stressed the importance of good food, wine, tepid baths and gentle exercise This advice recurs in various writings throughout the middle ages One

MIU—1

of the best known works of this time was *General Remarks on the Regimen of Old Age* by Avicenna (1181) He has much to say on healthy rules for living in old age He considered that the worst time of the year for the elderly was the winter, I think we would agree with him to day Shakespeare has much to say about old age, in *Macbeth* for example,

> I have lived long enough, my way of life
> Is fallen into the sear, the yellow leaf,
> And that which should accompany old age,
> As honour, love, obedience, troops of friends,
> I must not look to have

Again in *King Lear,*

> Pray, do not mock me,
> I am a very foolish fond old man,
> Fourscore and upward, not an hour more nor less,
> And, to deal plainly,
> I fear I am not in my perfect mind

and in *As you like it,*

> The sixth age shifts
> Into the lean and slippered pantaloon
> With spectacles on nose and pouch on side,
> His youthful hose, well saved a world too wide
> For his shrunk shank, and his big manly voice
> Turning again toward childish treble, pipes
> And whistles in his sound Last scene of all,
> That ends this strange eventful history,
> Is second childishness, and mere oblivion,
> Sans teeth, sans eyes, sans taste, sans everything

The most controversial book written about the time of the Renaissance was Roger Bacon's *The Cure of Old Age and the Preservation of Youth* He quoted freely from the Arabs, in particular, and the Greeks He divided old age into two stages "Senectus" from 35 to 60, and the "Senim" over the age of 60 Although the original work was, of course, written in Latin, there was an English translation in 1683 by Richard Brown of London Although there is much sound advice on food and drink and indeed on the philosophy of old age, much of it savours of the occult and black magic

In 1470, Marsilio Ficinio wrote an interesting book on how men might prolong their lives He believed in the value of magic for a restful old age and like so many other physicians of the time, stressed the importance of diet, and gave a special recipe for chicken broth, but warned about the dangers of love in old age He also recommended the sucking of young human blood and milk from the breast of a healthy young girl Many ancient civilizations have considered that bathing in or drinking the blood of young people or animals was of value in preserving health and delaying the ageing process No doubt this is the basis of that horrible custom practised by the Romans of rushing into the arena and drinking the fresh blood

of dying gladiators. Blood transfusion has been used several times in later centuries as a cure for ageing Some experiments went even a stage further and exchanged the blood of the sick and elderly for that of young and healthy animals There seems to be no record of exchange transfusion being practised on human beings, no doubt the lack of knowledge on blood groupings would cause serious accidents, but in addition to this the practice seems to have been frowned upon by the church and was generally prohibited

In 1558 Cornaro published his *Trattato de la Vita Sobria* He suffered from [illegible]

[illegible] ded music and singing as means to help in the mental problems of old age He recommended as articles of diet the testicles of various animals and birds, even in Spain to-day the testicles of the bull are credited with the same magic properties Throughout the 17th and 18th centuries a number of books on old age were written but nothing particularly new or original was contributed to our knowledge, *most of them merely* repeating what had been already said so many times before During the 19th century there were, of course, great advances in physiology and pathology and various books on the ageing process and the diseases of old age were published from time to time, such as Scudder's *On the Diseases of Old Age, as Connected with Plethoric State of the System* in 1815, Day's *Diseases of Advanced Life* in 1849 Daniel Maclachlan's *A Practical Treatise on the* [illegible] *Infirmitie* [illegible]

survey w [illegible]

up to th [illegible]

this subj [illegible] had been no sense of urgency in the writings of the various physicians as old age was rather taken for granted [illegible]

particular [illegible]

world w [illegible]

of west [illegible] in these countries an ageing of the population which is so marked as seriously to affect *our whole* social and economic life

DEMOGRAPHIC CHANGES

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[illegible] in the earlier age groups These [illegible] numbers of individuals were to [illegible]

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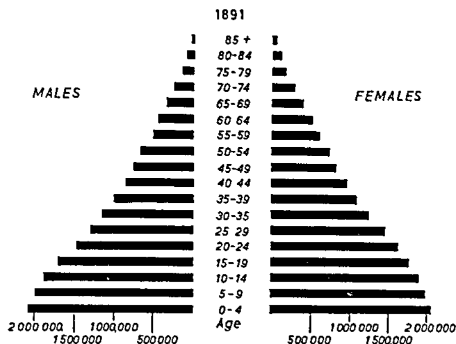
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to [illegible] pyramid depending to a large extent on what happens to the birth rate [illegible] pyramid will gradually revert more



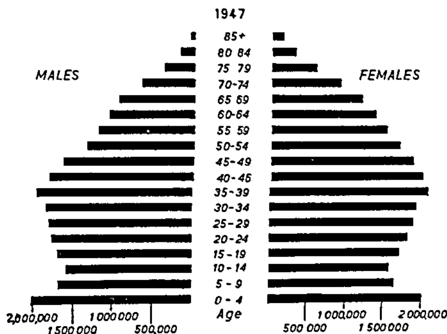


FIG 1 —Age pyramids for Great Britain 1891 and 1947

The situation is even more marked in France where the fall in the birth rate took place before it did in this country, whilst in America the situation is very similar to what it is here In the backward undeveloped countries, particularly in the East, the population distributions are still very much like those that existed in Great Britain 100 years ago There is a high birth rate and a high death rate so that the largest numbers of individuals are to be found in the early age groups, these, however, rapidly tail off, so giving a typical pyramid with the broad base tapering quickly to a sharp point Even in the East, however, preventive medicine is causing great decreases in the killing diseases such as malaria, and as the standards of living improve and education advances, so it is likely that the birth rate will fall and no doubt as these communities become industrialized and more urbanized the same changes will take place there Perhaps in 50 or 100 years time they too will suff

ecome of
gre problem
frc y people
concerned

s, pensions, diet, and social services and employment are of concern to a great variety of peoples and institutions

Report of Royal Commission on Population

After the war we awoke to the realization that these problems were upon us and one of the first steps taken was to set up a Royal Commission on Population to study the problem Its terms of reference were as follows

To examine the facts relating to the present

Its
Britain
in 1947
for the
that the population aged over 65 years in Great Britain would be 7 3 million and in 2007, 6 2 million The important thing however, is not only the absolute increase in the n
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of the pc
16 per ce
estimate those per cent Another
age is 60 years f
one fifth of the
enormous financial burden on the country, even if the amount of the pension is not increased it is estimated that it will cost the country something like £800 million in pensions alone by 1970 and an increase in the pension of only one shilling a week would cost something like £18 million a year There is considerable evidence however, that the present rate of pensions is inadequate

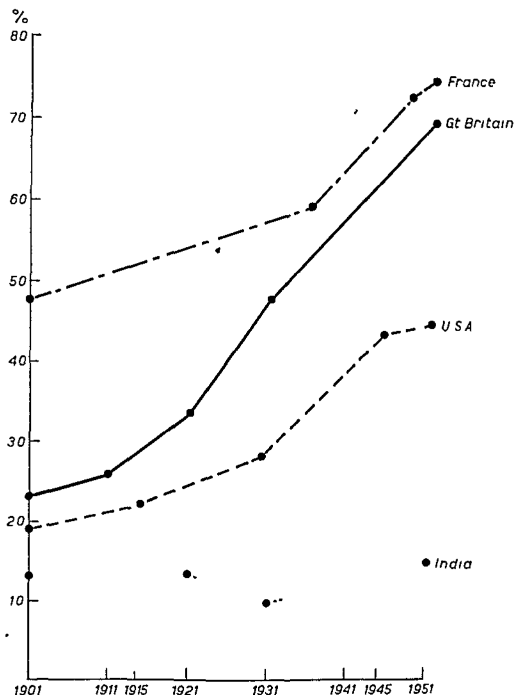


FIG 2 —Ageing of the populations of Great Britain France United States and India 1901-1951 For a definition of the index of ageing *see* text



FIG 3 — Live birth rates per 1 000 population, England and Wales 1841 1941

Index of ageing

These changes can be shown conveniently by means of an index of ageing This is defined as follows $\frac{\text{number aged 60 years and over}}{\text{number aged 0–14 years}} \times 100$, in other words it expresses the number of people of 60 years and over, as a percentage of those aged under 15 years.

Countries compared

The index of ageing for England and Wales, the United States of America, France and India since the turn of the century is shown in Fig. 2. It can be seen that India has remained virtually unchanged whilst the other countries have shown an upward trend beginning 30 or 40 years ago Crew (1946) has stated that

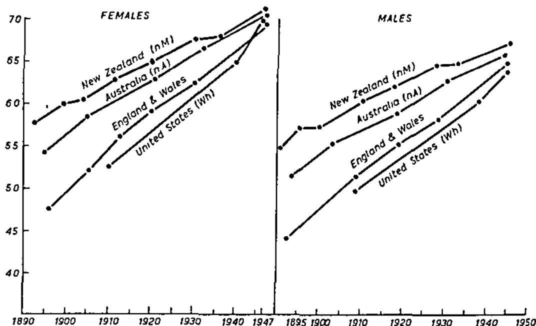


FIG 4 —Historical comparison of expectation of life in English speaking countries (white population only) (*By courtesy of Taylor and British Journal of Social Medicine*)

"the age composition of a population is among the best yardsticks that can be used for the assessment of the biological healthiness of a people" If that be true the western democracies would appear to be biologically becoming more unhealthy every day

Causes of upward trend of index of ageing

It is necessary to examine the causes for this trend Two main factors are responsible (1) A fall in the birth rate, and (2) an increase in the expectation of life at birth

... England and Wales is shown in Fig 3 ... there has been a steady decrease since 1880 ... changing pattern

of life throughout the 19th century In the early part of the century a large family was the rule, more children to work in the mills or the mines and to increase the family income, but with the spread of education, the introduction of control over the working hours and an increase in the standards of living, a large family became a burden The influence of the church and the importance of family life diminished towards the end of the century and in the 20th century there has been a great increase in the freedom of women, and cinema-going has become a regular habit Children have become an expensive luxury interfering with the pursuit of pleasure. The growth of knowledge of contraception has made all this possible All this means then that there are fewer children born to fill the younger age groups which is in marked contrast to Eastern countries, where the birth rate is exceedingly high to combat the effects of a high infant mortality rate Moreover ignorance and poverty make the practice of contraception an undesirable burden

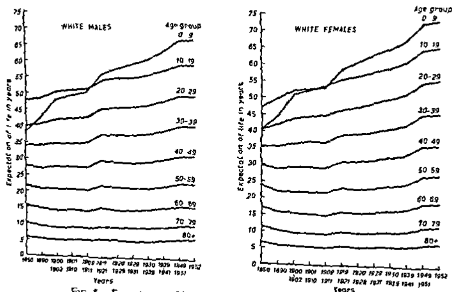


Fig 5 —Expectation of life by age in the United States, 1850-1952

F
age
Th
wh

l ... birth Fig 4 shows the trends over the last 50 years ... great increase in the expectation of ... in New Zealand, Australia, England and Wales and the ... for males and females ... population only) The ...
highest standard of ...
those in the United ...
United States of America was the large influence of young immigrants which ... in the population structure of the ... reached its peak between 1900 and 1910 when almost one million foreign born

persons enteredthe country each year It is to be noted that females are in all cases better off than males, due to the lower mortality rates subsequent on their living in the more sheltered environment of the home

The expectation of life at various age groups for the last 50 years is shown in Fig 5 which is taken from a bulletin of the Metropolitan Life Insurance Company giving figures for the United States, they are similar to those for Great Britain It shows that there have been very small gains in the older age groups Wallis Taylor (1951) in a more refined analysis of life table statistics has shown that "we are rapidly reaching saturation point with regard to the conservation of life in every age group under 60 years Henceforth, therefore, any continued increase of expectation of life at birth can come about, in the main, only from a lowering of the risk of death in the older age groups" This increase in the expectation of life which has brought about these changes has been due to a variety of causes, but chiefly perhaps due to the great achievements of preventive medicine It resulted in an enormous decrease in the mortality of such things as diphtheria, scarlet fever and measles Fifty years ago the death rate from these diseases was nearly 3,000 per million of population, to-day it is little more than 100 per million of population The general standards of living and of education and hygiene and the development of social services have also played their part Malnutrition is now almost unknown except possibly in the older age groups In more recent years the great advances in treatment, particularly the use of the sulphonamides and the antibiotics have reduced the fatality of many diseases, such as pneumonia and various streptococcal infections It is also possible to remedy although perhaps not to cure some of the degenerative diseases of old age

SOCIAL PATHOLOGY OF OLD AGE

Killing diseases

What then are the diseases which cause death to-day? The epidemic diseases attacking mostly the older age groups have been replaced by the chronic degenerative diseases of old age as a cause of death The mere fact that there are more old people in the community to-day means that there are more candidates available for these degenerative diseases The most important killing disease of to-day is degenerative heart disease, including coronary heart disease Next in order of importance are malignant neoplasms vascular lesions of the central nervous system and chronic bronchitis Deaths from coronary thrombosis and lung cancer are increasing each year Clearly arteriosclerotic changes in blood vessels are the most important cause of death to day, But, of course, apart from the killing diseases there are a great many conditions which cause disability and invalidism Fig 6 shows the number of invalids per thousand population according to age It reveals the sharp rise in invalidism over the age of 50 years We are getting increases, then, in those very age groups which require so much medical attention, thus causing a great increase in the amount of medical and social services required by the community The financial burden of people who cannot work is also enormous

Ill-health and disablement

Already sufficient work has been done to tell us the magnitude and extent of the problems of the elderly The survey of Hobson and Pemberton (1955) showed

at ill health in old age is to some extent related to poverty and that bronchitis, afness and dental caries are particularly related to social class factors As might expected, disablement increases with age, whilst ill health and disability are eater age for age amongst women than amongst men This is in marked contrast the fact that old women live longer than old men, or putting it in another way, omen have a greater expectation of life than men, in fact over the age of 85 years ere are twice as many females as males in the population It is common experience, erefore, that in the very old one usually sees more females than males as patients.

Cardiac disease—Undoubtedly the most important cause of disablement in the

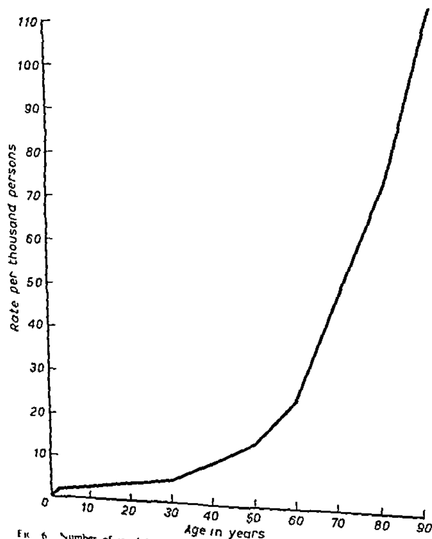


Fig 6 Number of invalids per thousand population according to age (S S P H S)

elderly is cardiac disease and, as might be expected, most of the conditions are those which result from arterial degeneration. Many have evidence of gradual diminution in the coronary circulation with cardiac pain and limitation of activity. In others interruption of the circulation takes place in more distal parts, such as the brain, causing paresis and mental changes, or in the legs causing intermittent claudication. Rheumatic heart disease is still fairly common but likely to become less so in the future, whilst cor pulmonale appears to be on the increase, perhaps partly associated with the better treatment of chronic respiratory disease, so that instead of dying of the respiratory component, they are more likely to die from secondary effects on the heart Syphilitic heart disease is now undoubtedly rare Other types of heart disease are hypertensive heart failure, degenerative aortic disease and a small group due to such things as myxoedema or Paget's disease Although heart disease is one of the most common of disabling conditions in the elderly, what is even more striking is the large number of people who have evidence of it, but nevertheless live full and active lives The same remarks apply to high blood pressure

Joint conditions —As a cause of disablement cardiac disease is closely followed by joint conditions, osteoarthritis and rheumatoid arthritis are common causes of limitation of activity

Fractures —Fractures and their after-effects are to be seen more often in elderly women, no doubt due to the type of household tasks they have to undertake and in both sexes defects of the feet are very common and easily remediable

Chronic bronchitis —Chronic bronchitis, with or without bronchospasm, is especially common in our northern industrial districts, and is closely related to the presence of atmospheric pollution, the cold, foggy weather is particularly dangerous to these people, and a smog will result in a large number of deaths and a worsening of the symptoms in many others

Impairment of the senses —The special senses are particularly important in the elder y impairment of hearing, vertigo, cataract, defects of vision, loss of taste and perversions of smell are all conditions which can affect the happiness of the individual, many of which also are capable of being remedied

Other diseases —Other serious disabling diseases are those of the genito-urinary and nervous systems

Psychological problems —*There is no doubt also that the psychological problems* of ageing are of considerable importance These are characterized by such things as apathy, carelessness about personal hygiene and appearance, depression, sleeplessness, eccentricity, anxiety neurosis, obsessional behaviour and in the final state, senile dementia A great deal can be done to minimize the severity of these changes and to prevent their development by judicious handling of the patient

Task of medicine

These, then, are the problems then which face the geriatrician We need to know more about the pathogenesis of these conditions but clearly their onset is determined by differences in hereditary factors and by the various ways in which people have lived For preventive geriatrics the two decades, 40-60, are probably the most critical Preventive medicine has been largely responsible for this state of

affairs and medicine as a whole cannot escape its responsibility for the life thus extended It appears that the actual life span has varied but little and the maximum age which can be achieved is to day as it was centuries ago, about 100 years This ... cannot extend even in the most favourable ... at least make the ... desires to live long ... es of advice given to achieve this aim For example Cicero said ... Thou shouldst eat to live, not live to eat, a sensuous and intemperate youth hands over a worn out *body to old age*" Perhaps the words of Oliver Wendell Holmes put it in a better way "I think as one ...

I have finally come to the conclusion that a good reliable set of bowels is worth more to a man than any quantity of brains"

THE GROWTH OF SOCIAL SERVICES FOR THE AGED

Since the second world war a great deal has been done to provide the various statutory social services for the welfare of the elderly The National Insurance Acts lay down the financial benefits for pensions and the National Assistance Act helps old people financially and has replaced the old Poor Law The National Health Service Act has been ... tion medicine free ... fully however how t... of their developmen... ... ities

Historical

There was no provision made for the care of *the aged* in primaeval times In fact a study of Neanderthal skulls shows that probably very few persons ever lived to be more than 45 years of age, most of them having died a violent death from a blow on the skull Certainly in the ancient civilizations of the Chinese and those described in the Bible provision was made for the care of the elderly During feudal times the sick and the elderly were cared for by their liege lord and those who did not come into this category were catered for b... the Reform... the so... relieve... by a s... ... several instances where in old age the head of the family agreed to hand over the family holding to the eldest son in return for keep for himself and his wife in their old age (*this rather* reminds one of the sort of *thing that* is sometimes done to day in order to avoid death duties) *It seems to have* been a favourite practice in the Manor of Halesowen in Worcestershire (*see* Burstein, 1948) The essentials provided were

(1) Housing that is a suitable room or cottage where they could live for the rest of their lives,

(2) Adequate clothing as befits the person's station in life

elderly is cardiac disease and, as might be expected, most of the conditions are those which result from arterial degeneration Many have evidence of gradual diminution in the coronary circulation with cardiac pain and limitation of activity In others interruption of the circulation takes place in more distal parts, such as the brain, causing paresis and mental changes, or in the legs causing intermittent claudication Rheumatic heart disease is still fairly common but likely to become less so in the future, whilst cor pulmonale appears to be on the increase, perhaps partly associated with the better treatment of chronic respiratory disease, so that instead of dying of the respiratory component, they are more likely to die from secondary effects on the heart Syphilitic heart disease is now undoubtedly rare Other types of heart disease are hypertensive heart failure, degenerative aortic disease and a small group due to such things as myxoedema or Paget's disease Although heart disease is one of the most common of disabling conditions in the elderly, what is even more striking is the large number of people who have evidence of it, but nevertheless live full and active lives The same remarks apply to high blood pressure

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to be discouraged. The three great deterrents were the stigma attached to it, the loss of freedom due to incarceration in the workhouse, *and the loss of voting* power, probably the latter did not worry many of the older people. The workhouses and Poor Law infirmaries were made as unpleasant as possible with the idea of ... and today we still have to use some of them ... treatment was given at many ... various cities in association with the hospitals. They were, of course, run on a voluntary basis. Treatment could also be given on the advice of the ... Officer, who was a loc... In the latter half of the ... *the age of 70* years had ... Aged Poor was set up and as a result it was laid down as a matter of Poor Law policy that outdoor relief was to be granted to destitute aged persons. This caused much consternation amongst Boards of Guardians, who had been using the threat of the deterrent discipline of the workhouse to shirk their responsibilities to the aged poor.

In 1909 the Royal Commission on the Poor Law and the Unemployed published its famous Majority and Minority Reports ... and Beatrice ... of the Poor L... of the Nation ... event of great *importance took* place in 1908 with the passing of the first Old Age Pension Act. The pension of 5 shillings a week was available to all people over 70 years of age subject to a means test. As can be expected, it took a considerable burden *off the Poor Law*. A great step forward took place *in 1929 with the* passing of the *Local Government* Act, which abolished Boards of Guardians, whose functions were taken over by Public Assistance authorities ... transfer the... the first tim... illness in the community. As a result, many of these hospitals were improved and *were brought up to the highest standards*. These ... concerned ...

... *worse and* were accentuated ... of the second world war in 1939. Since the end of the second

(3) Food and drink, often specified in great detail Thus in an agreement made between Agnes of Ridgacre and Thomas, her elder son, dated 23rd October, 1281, he must provide "at Michaelmas and Christmas a quarter of oats, a quarter of wheat and a bushel of peas, at Midsummer and on Good Friday, the wheat and the oats without the peas, and if he had not the grain ready at the proper time, he was to give her the proportionate price of the best grain on the market".

(4) Fuel "On every All Saints Day five cart-loads of coal".

(5) Pocket money "Five shillings of good money every Pentecost".

Those who had children sometimes handed over their land in return for their keep By the end of the 14th century there was a definite movement from the country to the towns, feudalism was nearing its end and it was now becoming the custom to pay for labour As a result the problems of unemployment arose, as there was no longer a lord responsible for his servants' welfare.

Beginning of social conscience

In 1504 we see the passing of an Act which indicated the first beginnings of a social conscience as far as the elderly were concerned although the responsibility was put firmly on the shoulders of the local charities, usually monasteries, gilds or parish clergy, for it was to be another 350 years before there was any form of local government It was realized that unemployment might be due to the weakness of old age, and persons over the age of 60 years were absolved from being punished for vagrancy

First almshouse for the elderly

In the 12th century we hear of the first almshouse or Maison Dieu for housing the elderly and infirm In 1136 Bishop Henry de Blois founded St Cross Hospital, Winchester, to support "thirteen poor men, feeble and so reduced in strength that they can hardly or with difficulty support themselves, without another aid" The greatest number of these retreats for the elderly however, were built in the 16th century with its great flood of social disorder and poverty Nevertheless these voluntary institutions were quite inadequate to cope with the problem The lack of economic security for the working man was described in 1516 by Sir Thomas More in Utopia "and the remembrance of their poor indigent and barren old age killeth them up For their daily wage is so little, it will not suffice for the same day, much less it yieldeth any over plus, that may be clearly laid up for the relief of old age"

History of the Poor Law

Following the dissolution of monasteries many of the aged and infirm were left uncared for and so in the reign of Queen Elizabeth there was the beginning of the first Poor Law, that of 1601 remained the law of the land for over 200 years, and nearly 100 years later the first workhouse was erected at Bristol and like many of the worth-while voluntary efforts it failed for economic reasons The Poor Law Act, however, was based on more secure grounds A compulsory poor law tax was levied and in every parish there were overseers of the poor It was their duty to provide accommodation for the aged poor The act of 1601, however, did very little to help the aged sick It was not until 1782 that an Act was passed to make general the provision of workhouses for the aged, the sick and infirm, but this again

Research into problems of ageing

Since the war, England has met a challenge of caring for the needs of the elderly in a remarkable way, but although much has been done, there is much still left o do in fighting apathy, ignorance and ill-health In the first place, we require not only fundamental research into the problems of ageing, but also a great deal of nformation on the practical problems involved

Nuffield Foundation enquiry

The first enquiry into the problems of ageing and the care of old people was made by Mr H Seebohm Rowntree under the authority of the Nuffield Foundation in 1944 Its terms of reference were as follows

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One of the results of this was the formation in 1947 of the National Corporation for the Care of Old People.

Other surveys

In 1947, there was published *Old People A Report of the Survey Committee on the Problems of Ageing and the Care of Old People* Representative surveys were made in York, Wolverhampton, Oldham, the Rhondda valley, Wandsworth and St Pancras Rural areas in Lutterworth, Midhurst and Cambridgeshire were also investigated A pioneer study in the medical field was that of

(Hobson and Pemberton, 1955) The National Council of Social Service has also fostered an interest in the problems of old age and drawn together the very many social agencies concerned They fostered the publication of a book by Lord Am

written by Exton-Smith (1955). of the Regional Hospital Boards are alive to the problem of the care of the elderly and chronic sick and many have appointed Geriatric Advisory Committees, there have been numerous reports from these bodies and from hospitals on the problems The Geriatric Advisory Committee of the Sheffield Regional Hospital Board carried out a survey in its area in 1950 and published a report in 1951 Thomson, Lowe and McKeown (1951) published a report for the Birmingham Regional Hospital Board

These reports indicated the main administrative problems relating to the care of the elderly following the passing of the National Health Service Act One of the

world war however, remarkable changes have taken place in the standards demanded for the care of the elderly in hospital.

Voluntary Services

Whilst these changes were taking place in the law of the land a great deal had been done by voluntary effort, particularly in the founding of almshouses The money was usually contributed by some philanthropists for the aged poor of the parish, or some particular guild or city company In addition to a dwelling house they were often given something in kind or in money, Royal Maundy is one of the best known of the benefactions of this type The sovereign presents small amounts of money to each well-behaved aged resident of the city of Westminster

Estate employees

Before the days of the Industrial Revolution the elderly employees of the large estates were usually looked after in their retirement, provided with a cottage and a pension, and, with their smallholding, were usually quite well off Even to-day there are still a few of these estates left, but they are gradually decreasing with the increase of taxation and the prohibitive death duties Dr Alexander has recently carried out an interesting survey of the elderly employees living on the Chatsworth Estate of the Duke of Devonshire This reveals in a remarkable way the extent to which they benefit from the help given by the Duke

Friendly Societies

The Friendly Societies are another example of voluntary effort which can be traced from the 15th century A Friendly Society has been defined as "a Society for good fellowship, for the purpose of raising from time to time by voluntary contributions a stock of funds for the mutual relief and maintenance of all and the members thereof in old age, sickness and infirmity, or for the relief of the widows and orphans of deceased members" They gradually grew in size and importance throughout the 19th century with the advent of the Industrial Revolution and they administered the funds of the National Health Insurance Act of 1911, despite the advent of state provision for money benefits, there are still many of these Friendly Societies in existence to-day Some famous almhouses are those provided by the Linen and Woollen Drapers, the free churches at Northampton, the Church Army, the Salvation Army, and the Catholic and Anglican sisterhoods

National Old People's Welfare Committee

In 1944, a voluntary body was set up to bring together all the major societies concerned with helping the elderly This was called the National Old People's Welfare Committee It also formed local Old People's Welfare Committees, and these have done a great deal to co-ordinate local effort, providing for the needs of old people They set up homes and clubs for the elderly, organized visiting schemes and provided "meals on wheels" services which have in many cases been followed by official schemes However much the State makes provision for the elderly there will always be need for voluntary effort and help

Adequate physical activity, the avoidance of an excessive consumption of fatty foods and the control of body-weight are practical measures which might be expected to reduce illness in the elderly. It is probable that such advice, if it is to be effective, must be taken before the onset of old age

Residence in a crowded industrial area where the air is heavily polluted is a factor adversely affecting health in the elderly, particularly with regard to chronic respiratory disease. This was shown most dramatically by the great increase in deaths from respiratory disease amongst the elderly during and after the prolonged fog in London in 1952 (Logan, 1953)

The work of Doll and Bradford Hill (1952) indicates that some at least of the recent increase in cancer of the lung is due to heavy cigarette smoking and is therefore to that extent preventable It has been suggested that heavy smokers should undergo routine chest radiography from the age of 45 years onwards with the object of [illegible]

[illegible] experience in their homes Well-lighted and more convenient dwellings for the elderly offer the means of reducing the number of accidents in this age-group

Nutritional deficiency disease is now rarely seen in children in Great Britain and serious malnutrition in the [illegible]
decades ago [illegible]
to hospital of [illegible]
is fairly comm[illegible] old man who has scurvy is no great rarity The [illegible]
for th[illegible]

[illegible] lack of knowledge of what food to buy and how to prepare it is most likely to affect the elderly man who has recently lost his [illegible]
to [illegible]
his [illegible]
hu [illegible]
ap [illegible] and becomes in consequence ill and decrepit The increasing use now being made of health visitors for advising and encouraging old people in this sort of situation and of the "meals on wheels" service are valuable preventive measures

Little attention appears to have been [illegible] needs of the
[illegible] vitamin C,

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most important has been lack of liaison between the general practitioners responsible for general medical care, the local authority responsible for welfare, housing and domiciliary services and the hospitals who are responsible for hospital care The lack of hospital beds has been aggravated by the shortage of general accommodation for the elderly infirm who are not necessarily *requiring medical attention*, so that a number are retained in hospital for social reasons The general shortage of money has meant that there has been virtually no new building since the war so that although much has been done to make the best use of the very poor accommodation available, shortage of finance has also meant that there have been grave deficiencies in adequate staff for the ancillary services such as almoners, physiotherapists, occupational therapists and chiropodists The work of such pioneers as Lord Amulree, Cosin, Trevor Howell, W. Morton and Marjory Warren has shown what can be done with limited resources

Geriatric societies

Since the war a number of societies have been formed for the study of geriatrics In Great Britain there is The Society for Research in Ageing and the Society for the Medical Care of the Elderly In America there is the Gerontological Society, the American Geriatrics Society and in addition several states have their own societies, for example the Texas Geriatrics Society The third congress of the International Association of Gerontology was held in London in 1954 and a report of its proceedings appeared in 1955 called *Old Age in the Modern World* This contains a valuable series of papers on all aspects of gerontology

Journals

There are several journals devoted to the subject in America but so far none in Great Britain The American ones are as follows *The Journal of Gerontology*, *The Journal of the American Geriatrics Society*, and *Geriatrics* There appear to have been no comprehensive text-books of geriatrics published in Great Britain but in America there are those by Cowdry (1952), Stieglitz (1954), and Thewlis (1954) Shock (1951) has published a useful bibliography of gerontology listing a comprehensive selection of references on *all its aspects up to the year 1950*, this is kept up to date by a list of references in each issue of the *Journal of Gerontology*

PREVENTION OF DISEASE AND DISABILITY IN THE ELDERLY

The prevention or delay in the development of arteriosclerotic heart and cerebral disease would make the greatest single contribution to the health of the elderly So far, however, we have only one or two uncertain clues as to how this might be achieved Morris and his colleagues (1953) have produced suggestive evidence that [illegible] artery occlusion [illegible] encourages the [illegible] that obesity reduces the expectation *of life and that it is* also associated with diabetes mellitus and with gallstones This survey has provided evidence that a high dietary fat intake raises the serum cholesterol level

[illegible]

Company

Thomson, A P, Lowe, C R, and McKeown, Thomas (1951) *The Care of the Ageing and Chronic sick* Edinburgh, Livingstone.

Elderly people are often loth to consult the doctor for conditions which are not painful and do not disable them Quite often they believe that these are the inevitable concomitants of old age Even amongst doctors there is sometimes found an unnecessarily fatalistic attitude

Normally, post-mortem examinations are carried out to determine the cause of death There might be a fruitful field of research in using routine post-mortem examinations to investigate the pathological basis of associated non-fatal conditions such as vertigo

There is great scope for further studies of the elderly living in the community as well as in special institutions If serious attempts are to be made in preventing some of the illnesses which characterize advancing age, we need to know more about their earliest stage and the circumstances under which they develop We need also to study a group of similar individuals who remain healthy One of the most promising ways in which advances in this direction might be made is by *means of long term follow-up studies of individuals from middle age onwards*

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The fusion between the egg and the sperm which occur in more complex organisms is analogous to the process of conjugation in protozoa

Conjugation appears to act as a rejuvenatory process although it does not perpetuate the strain for ever The process of conjugation usually takes place in protozoa (for example Paramecia) which have a macro nucleus and a micronucleus Following attachment of the cell bodies to each other the micro nuclei of the two individuals change places and the two organisms then usually encyst and divide up into a number of smaller and rejuvenated daughter cells However, despite relatively frequent conjugation, strains of protozoa are known to die out, this process being characterized by a decrease of growth rate followed by a degeneration of both the macro nuclei and micro-nuclei and eventually disappearance of the latter On the other hand some strains of protozoa have been kept for thousands of generations without any signs of conjugation However, death eventually overtakes even these strains Senescence and death are widespread amongst protozoa and they must not be thought of as being capable of continuous rejuvenescence (Jennings, 1945)

Sonneborn (1955) has demonstrated that the senescence of Paramecia is due to the fact that the macro nucleus which controls the metabolism of the cell is highly polyploid and at cell division there is a random distribution of chromosomes However in the beginning there are so many sets of chromosomes due to the high degree of polyploidy that the daughter cells all manage to get at least one complete set As division continues the number of chromosomes becomes reduced and the chances of any individual receiving an incomplete set is correspondingly increased The result is progressively impaired physiological activity leading ultimately to death Although the lost chromosomes might be restored from the micro nucleus following conjugation even the latter process is eventually affected when the deficiency in the macro nucleus becomes such that the abnormal metabolism affects the micro-nucleus Comfort (1955) makes the comment "In ciliates the germ plasm has to live in the cell where the processes of somatic maintenance are carried out and it is therefore unusually exposed This is probably a unique situation it does not even apply in other ciliates"

Amongst the organisms still lower in organization senescence and death are terms more difficult to define Do viruses and bacteriophages undergo senescence? When a bacteriophage attacks a bacterium it passes nucleic acid into it The
nucleic acid compete

young and vigorous virus protein
which can re infect other bacteria Has such a bacterial cell really died? The
character of the proteins produced by the animal bod
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this eddy swelling in size and growing in vigour during the growth
period and then gradually getting slower and slower until it fades away and ceases

CHAPTER 2

AGEING FROM A BIOLOGICAL AND CELLULAR POINT OF VIEW

GEOFFREY H. BOURNE

FROM the moment a cell, which is destined to become an ovum, is formed in the ovary it begins to age and in doing so it matures With the process of fertilization cell division commences and the cells so-formed in this way age continuously and differentiate into organs and tissues For a time these cells and tissues grow and develop and when they have reached the peak of this activity they commence to undergo senescent changes which culminate in death (What mechanism is it which permits such abundant growth and cell division in the organism up to maturity and then not only brings these processes to an end but guides them into a steady and fatal decline? Here is the central problem of gerontology) and it can be answered only by fundamental investigation on a cellular level

IMMORTALITY AND CELLULAR LIFE

It has been said that cells which continue to grow and divide remain young and do not age, but the cells of the central nervous system, which cease dividing very early in the life of an individual organism, appear to age no faster than the basal cells of the skin which are in a continuous state of growth and division during the lifetime of an individual Some writers during the first part of this century were impressed with the "potential immortality" first of protozoan and secondly of metazoan cells *in vitro* In both these examples the individual cell grows to its limit then divides, and the two young, rejuvenated cells commence the cycle again Yet, in producing two young cells in this way the original cell has lost its identity and the daughter cells are usually regarded as being two completely new individuals *However, there are exceptions to this In some protozoa some of the old* organelles are passed to one individual and the other has to regenerate them afresh In "suctorians" there is evidence that one of the individuals remains as a "parent" and gets older, having a fixed life-span despite the fact that it divides Apart from this there are many examples of apparent rejuvenation of both daughter cells following division Why should this rejuvenating effect occur? If we think of the process as one of immortality we should even regard such a complicated organism as man as also being immortal, since one of his germ cells, following fusion with another germ cell gains with it the joint ability to grow, divide and produce a complex organism which itself produces fresh daughter cells to continue the line If the term "immortality" is used for single cells then we must accept the fact that all living cells are immortal and are capable of continuous production of rejuvenated cells which perpetuate themselves The term "immortality" in regard to cellular life is in fact meaningless and its use should be discontinued

nucleic acids appear to be related to protein synthesis. It may be that once a cell reaches a certain size growth comes to an end because the synthetic capacity of the existing DNA is outstripped With a duplication of DNA, however, fresh growth can begin An analagous thesis is elegantly expressed by Comfort (1954) as follows:

> A theory of "mechanical ageing" could be based upon the exhaustion of cell catalysts It is reasonable to ask how much of the senescence of such cells, if they necessarily undergo senescence is due to the existence of "expendable" enzymatic or other intra-cellular structures which can be replaced only at cell division It is known that enzyme molecules have a finite life span in terms of molecular turnover. The wastage of such systems is due, presumably, in part to side reactions and in part to competitive inhibition or blocking by metabolites partially resembling the correct substrate The existence of other enzyme systems renewed only at cell division has not, it appears, been demonstrated but with a single general exception it has not been sought

The concept of immortality of single cells brought with it the precept of inevitable senescence and death in all metazoa However, this may not be so There is evidence that sea-anemones may live for nearly a hundred years without showing signs of senescence Such complicated vertebrates as fish, and possibly some amphibia and reptiles do not appear to undergo characteristic senescent changes and it may be significant that such animals continue to grow throughout life However, it is now known that in small fish there is evidence of senescence similar to that found in mammals

Nevertheless, most metazoa show signs of senescence with the passage of time and this is the invariable rule in mammals The problem of the cause of ageing in metazoan animals is very complex since cells age at different rates. Some cells for example multiply continuously throughout life and show many cycles of ageing (for example the skin), others never multiply and show a single ageing cycle (for example, neurones)

CLASSIFICATION OF CELLS ACCORDING TO AGEING PROCESS

Cowdry (1952) classified cells of the body, with respect to ageing, in the following way

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to exist. The idea that "wear" and "tear" is a factor in ageing appears therefore in the light of what has just been said to have no significance at all.

Tissue cells in culture, like protozoa, have been said to be "potentially immortal".

If cells are cultured in saline they degenerate fairly rapidly but in organic media which must include embryo extracts they will, provided they are sub cultured every few days into fresh media, continue to grow and divide for many years beyond the life-span they would have had *in vivo*. Ten years of culture involving nearly 2,000 generations of cells is not unusual. If such cells are not sub cultured they go through a series of changes, graphically described by Lewis in 1924. In cultures of tissue from various organs some cells degenerate more rapidly than others, mesenchyme cells for example degenerate more slowly than cardiac muscle cells and in cultures of the liver the endothelial cells of the sinusoids degenerate before the hepatic cells. The first signs of degeneration in such cells is the appearance in the cytoplasm of small granules different from normal segregation granules but which have a considerable affinity for neutral red. At first they appear solid and then aggregate around the centriole. This is followed by the development of a vacuole around individual granules or groups of granules. Lewis believes that these vacuoles arise from autolysis of cell constituents or to an accumulation of waste products.

As degeneration progresses the mitochondria break up into rods and granules or swell up into small vesicles accompanied by a net decrease in mitochondrial substance. Nuclear changes also occur, the nucleus may divide without mitosis into two or more parts and vesicles of nuclear sap may be squeezed out into the cytoplasm. In some cells the nuclear wall may break down and the whole nucleus may liquefy. The cell itself, although rounding up, sends out small beleb like processes from its surface. Up to this stage the degenerative changes can be reversed by the transfer of the cells into fresh medium. If they are not transferred by this time, however, certain irreversible changes take place and death becomes inevitable. The normally clear and apparently homogeneous nucleus becomes cloudy, many minute granules (spoken of as "death granules") appear in the cytoplasm which do not take up neutral red like the granules mentioned earlier. Eventually the cytoplasm becomes completely filled with these granules, all motion stops and the cell is dead.

Embryo extract is the most important part of tissue culture media since it prevents these changes from occurring. Attempts have been made to discover the nature of the factor in this extract which has such a potent effect. In the study of the nutrition of single cells by building up synthetic media composed of various amino acids, minerals and vitamins it was found that something else was still needed. This substance appears to be present in an extremely fine particulate fraction of the extract and there is evidence that this is either free or conjugated nucleic acid (Weymouth, 1954).

The process of cell division results in rejuvenation of cells and it is of interest that it is at this period that new desoxyribose nucleic acid (DNA) is produced and incorporated into the nuclei of both daughter cells. This has been well demonstrated by the use of radioactive phosphorus (Pelc and Howard, 1953). Perhaps this fact has some relation with the rejuvenescence of the cells particularly as

in association with sclerotic blood vessels. In these cases therefore the changes of the mitochondria are secondary to change in the blood vessels and where the latter remain intact the mitochondria seem unaffected, at least morphologically The relationship of mitochondria to ageing processes in cells is potentially of great importance since 80–90 per cent of the aerobic metabolic processes of the

both testes in rats causes a considerable decrease of the

(a respiratory enzym

being greater after t

Unpublished work) However, the problem of the relationship of the endocrines to ageing will be discussed later

The pituitary

Mitochondrial changes with old age have also been described in the pituitary. In the cells of the anterior lobe they become converted into irregular or spherical shaped bodies which increase in size and then fuse In the basophils this may be followed by complete destruction of the cells In the cells of the germinativum in ageing skin there is a reduction of the number of mitochondria and there is of course complete loss of mitochondria in cells undergoing keratinization.

Nerve cells

Nerve cells are of special interest from the point of view of ageing At an early stage in development they become fixed as post-mitotics and undergo characteristic age changes throughout life

"Senility" pigments

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in pigment has also been described in the ganglion cells of rabbits (Gatenby and Moussa 1951)

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Ceroid pigments

The term 'ceroid' has been loosely applied to senility and other pigments by a number of authors and it may be as well to clarify it The word was first used by Lillie (1942) for a type of

greenish-yellow with

(4) *Fixed post mitotics*—These are highly differentiated cells and are not able to carry out further division They include blood cells (erythrocytes and leucocytes) muscle cells and nerve cells

Difficulty of classification

It is obviously difficult, therefore, to give a general scheme for ageing in cells since those of different organs age in different ways and at different times for example the cells of the stratum germinativum of the skin do not age for a very long time if at all, since they come into the category of vegetative inter mitotics



Fig 7 (a) Giant cell of Betz from a 29 year old man The Nissl bodies are large and deeply stained (× 1495) (b) giant cell of Betz in the motor cortex of a woman of 78 years Small amounts of pigment are present in the nerve cell but significantly one of its satellites that on the right contains prominent pigment granules Professor Warren Andrew believes that satellite cells actually remove such material to some degree at least from large nerve cells (× 1495) (c) Purkinje cell of a 72 year old woman showing relatively clear nucleus and abundant Nissl substance
(Reproduced by courtesy of Prof Warren Andrew)

Salivary glands

In cells such as those of the salivary glands characteristic changes occur in mito chondria with age (Kurtz and Andrews 1951) In the sub maxillary gland of the rat for example the mitochondria are short fat rods but they change into long tenuous filaments in senile animals and there is also an overall diminution of total mitochondrial substance In the parotid gland on the other hand the mito chondria are elongated in the young animal but in senility they change to the short plump form

Kidney, pancreas, and liver

There are striking changes in the morphology of the mitochondria in parts of the senescent kidney, pancreas and liver, but these appear in localized areas mainly

in association with sclerotic blood vessels In these cases therefore the changes of the mitochondria are secondary to change in the blood vessels and where the latter remain intact the mitochondria seem unaffected, at least morphologically The relationship of mitochondria to ageing processes in cells is potentially of great importance since 80–90 per cent of the aerobic metabolic processes of the cell are localized in them and since it has been shown that there is a decrease in the respiratory activity of the tissues in old age (Rafsky and his colleagues, 1952) It has been shown histochemically that removal of both adrenal glands or of both testes in rats causes a considerable decrease of the succinic dehydrogenase (a respiratory enzyme) reaction of the kidney, liver and heart muscle, the reduction being greater after the former (Bourne and Malaty, 1953, Malaty and Bourne, Unpublished work) However, the problem of the relationship of the endocrines to ageing will be discussed later

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Nerve cells

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"Senility" pigments

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appears in this region

spreads throughout the cell It is of interest that in vitamin E deficiency pigment occurs in many cells and some authors have thought that the so-called senility pigments may be due to this deficiency, however, there is evidence that the pigments of vitamin E deficiency are different from those due to senility (Payne 1949)

Ceroid pigments

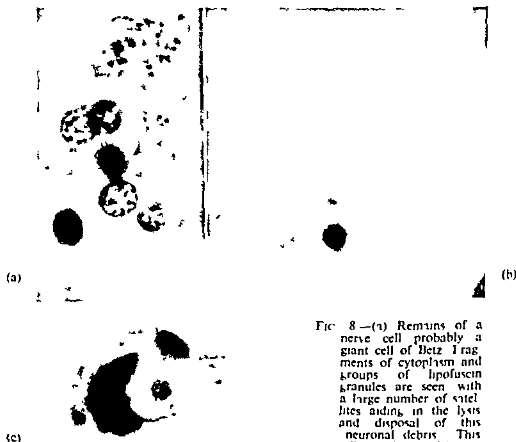
The term ceroid has been loosely applied to senility and other pigments by a number of authors and it may be as well to clarify it The word was first used by Lillie (1942) for a type of pigment

cells

a greenish yellow with

the longer wave lengths of the ultra-violet Only pigment which has these properties is therefore entitled to be called ceroid

Hartroft (1953) has described pigments in the trabeculae of cirrhotic livers of rats on a choline deficient diet and in or around the lipid deposits in atheromatous arteries of human subjects These pigments answer some at least of the criteria of ceroid Hartroft found it in renal, iliac, femoral, cerebral and coronary arteries He thought that it might form by means of a reaction between the tissue lipid and the membranes of red blood cells He obtained pigment like products from test-tube experiments with red blood cells and unsaturated fats This has been confirmed (Casselman, 1951) and it has been found that the more unsaturated the lipid and the greater the oxidizing power of the tissue, the more pigment is produced Where small haemorrhages were present around lipid deposits in atheromatous arteries Hartroft invariably found ceroid like pigment produced and he distinguished two types of ceroid (mostly on appearance) which he called *homoderoid and hyalceroid*



(a) (b) (c)

FIG 8—(a) Remains of a nerve cell probably a giant cell of Betz Fragments of cytoplasm and groups of lipofuscin granules are seen with a large number of satellites aiding in the lysis and disposal of this neuronal debris This cell was from a 78 year old woman × 1495 (b) peculiarly shaped Pur

It is probable that the pigments present in nervous tissue are also ceroid but further information as to their origin and exact nature is required A pigment h s heen d d ... it be of this ... ivity (Sulkin ... the cells of these ganglia with age and there is a peripheral chromatolysis the nuclei become pyknotic and displaced The cell in general becomes shrunken and pigmented and there is a shift in the nucleo-cytoplasmic ratio in the direction of the nucleus (Sulkin and Kuntz 1952) Sensory ganglia seem much more resistant to age changes for they do not show the features characteristic of ageing autonomic ganglia

Golgi region

Changes are also apparent in the Golgi region of the cell In a young dog the Golgi apparatus is composed of a loosely woven network and is either restricted to the peri nuclear portion of the cytoplasm or else extended right through it In senile dogs this network like structure cannot be seen Many cells show very little material with the same staining reactions as the Golgi material but where it occurs it is in the form of discrete granules

Ganglion cells

There is a strong alkaline phosphatase reaction in ganglion cells which is scarcely decreased even in the senile dogs On the other h nd in the ...
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posi ... glycogen but some form of mucopolysaccharide It is of interest that this material is also found in the autonomic ganglia of man but it is in association with the pigment granules

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... This raises a query as to which of the senile changes in other organs are due to deficiencies and which are true senility changes

C

(Bateman and Papez 1951) Such particles are presumably extruded from the cytoplasm and become embedded in the walls of blood vessels where they may give rise to sclerotic patches The nuclei of such old nerve cells become pyknotic and show an increase in nuclear histone This may indicate a diminished capacity on the part of the nucleus to synthesize nucleic acids In addition to pyknotic changes the nucleus may show an internal brushwork arrangement attached to one side of the nuclear membrane also the nucleoli may show a honeycombed rim This has been interpreted as indicating a failing metabolism although it may indicate many other things

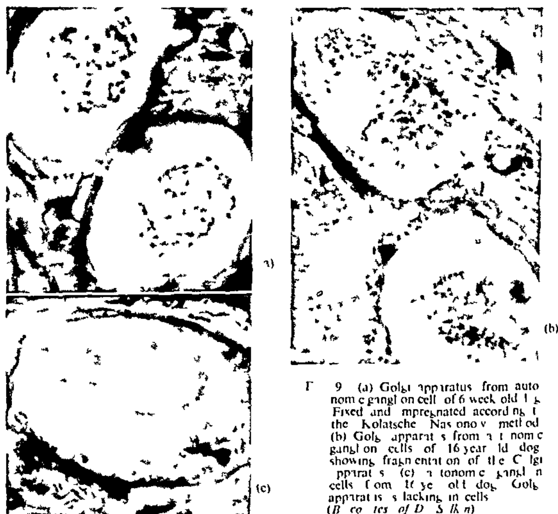


Fig 9 (a) Golgi apparatus from autonomic ganglion cell of 6 week old [illegible] Fixed and impregnated according to the Kolatschev Nassonov method (b) Golgi apparatus from autonomic ganglion cells of 16 year old dog showing fragmentation of the Golgi apparatus (c) autonomic ganglion cells from 16 year old dog Golgi apparatus is lacking in cells
(By courtesy of Dr S [illegible])

Neurofibrils

In the nerve cell cytoplasm changes are detectable in the neurofibrils which are attributed primarily to changes in the structural protein of which they are composed This change may be the principal one concerned in lack of function although of course it is not known what part neurofibrils (if they exist in life) play in the function of the nerve cell

Sosa (1952) has studied neurofibrils in the cells of the human central nervous system (cerebral and cerebellar cortex, medulla, oblongata, spinal cord and ganglia). He found that in the early stages of senility there was a dissociation and then an agglutination of the neurofibrils ending with complete neurofibrillolysis. These changes took place in association with the development of a lipofuscin pigment Sosa described this type of degeneration as "lipochrome" or "lipofuscin neurofibrillar degeneration"

Cells of Cajal

In the ganglia of old subjects certain degenerated cells which are now described as the ragged (senile) cells of Cajal can be seen (Cajal, 1906) The surfaces of these

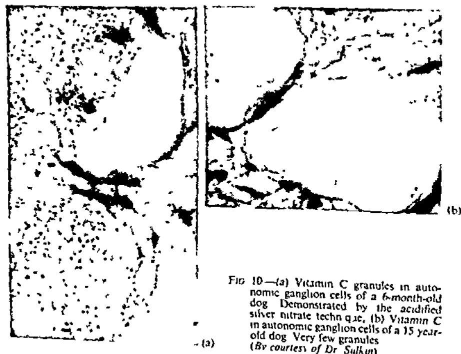


FIG 10—(a) Vitamin C granules in autonomic ganglion cells of a 6-month-old dog Demonstrated by the acidified silver nitrate technique, (b) Vitamin C in autonomic ganglion cells of a 15 year-old dog Very few granules (*By courtesy of Dr Sulkin*)

ragged [illegible]

[illegible] normal healthy adults (Penfield, 1932) [illegible] cells can be found in found in animals after the ganglia have been subjected to compression or after damage to the nerve roots

Loss of Purkinje cells from cerebellum

One of the very interesting aspects of the ageing nervous system is the loss of Purkinje cells from the cerebellum Attention was drawn to this fact by Hodge as long ago as 1894 He claimed a 25 per cent loss of these cells in a man of 92 years compared with an adult man of 47 Harris in 1927 said that in old apes there were

only 6 Purkinje cells in senile tissues for every 41 in young apes, and Spiegel (1928) found a 40 per cent loss of Purkinje cells *in senile guinea pigs* Andrew (1955) found in a woman of 80 only 5 or 6 cells (of which only 2 appeared to be functional) for every 20 in a younger woman Ellis (1920) listed the following numbers of Purkinje cells per given area of cerebellum in men of different ages 42 years, 823, 65 years, 591, 79 years, 500, 94 years, 462, 100 years, 445 It is of interest that in histochemical enzyme preparations of the cerebellum (phosphatases and respiratory enzymes) many cells show greatly decreased or negative activity and it is probable that the ageing and disappearance of these cells is preceded or accompanied by loss of enzyme activity. This decrease in cells is by no means restricted to the cerebellum, for Truex (1940) and Truex and Zwemer (1942) showed that fatty degeneration of cells in the sensory ganglia of man resulted in a loss of quite a number of neurones after middle age He found the same result in the Gasserian ganglia and spinal ganglia of old cats and rats Brody (1953) did a series of cell counts in the cerebral cortex and he found a significant loss of cells with age Andrew (1955), commenting on their results, pointed out that some nerve cells may undergo amitosis during the ageing of the organism, presumably in an attempt to compensate for this loss There is some doubt as to whether this process ever results in new cells although binucleate cells become quite common in spinal ganglion cells and elsewhere in old age

The chromidial substance of the cell may supply the energy needed for its activity and thus continuous stimulation of these cells leads to a considerable decrease in or even a disappearance of chromidial substance (Kuntz, 1952) It is known that this material disappears from the neurones of birds following a long *migratory flight A study of changes in chromidial substance in a variety of nerve* cells at different ages might prove of considerable interest

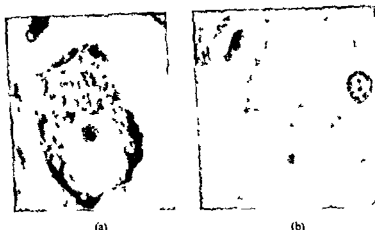
We have seen from this brief review of a small sample of the mass of literature dealing with the ageing nervous system that certain characteristic changes occur but we do not know for certain whether they are changes due directly to ageing or whether they are secondary in nature The relationship of vitamin C deficiency to them has been mentioned and there also exists the possibility that many of the changes may be due to vascular deficiency Minor vascular changes may lead to some of the cell alterations already mentioned but severe vascular changes lead to irreversible (for example, necrotic) changes in the cells Changes due directly to alteration of the vascular system result in the occurrence of argentophil debris between the cells, senile plaques, gliosis, sclerotic fibres, amyloid bodies and perivascular demyelination These are no doubt due partly to lack of oxygen and to failure of adequate nutrition for the cells and their processes (Bateman and Papez, 1951)

Mammalian erythrocytes

Comfort (1955) has drawn attention to the ageing of the mammalian erythrocyte Life tables have been constructed for this cell and the type of curve which results is similar *to that which can be obtained for* whole metazoan organisms Such curves demonstrate that there is even an "infant mortality" among erythrocytes [illegible]

haemoglobin iron in the Fe^{++} condition Comfort points out that there are almost certainly in addition changes in the physical properties of the stroma and/or of the cell wall

Whether these changes can be attributed to the absence of a nucleus is not certain but it is of interest that in the avian erythrocyte, which does contain a nucleus there appears to be continuous synthesis of haemoglobin even when the cell is in circulation but the anomaly here is that the life of the cell is much shorter than that of the mammalian erythrocytes.



(a) (b)

FIG 11 —(a) Autonomic ganglion from two-year-old dog stained with toluid ne blue showing Nissl pattern (b) autonomic ganglia from a 14-year-old dog showing reduced and altered Nissl pattern.
(*B*) *courtesy of Dr Sulkin*)

Axillary apocrine sweat glands

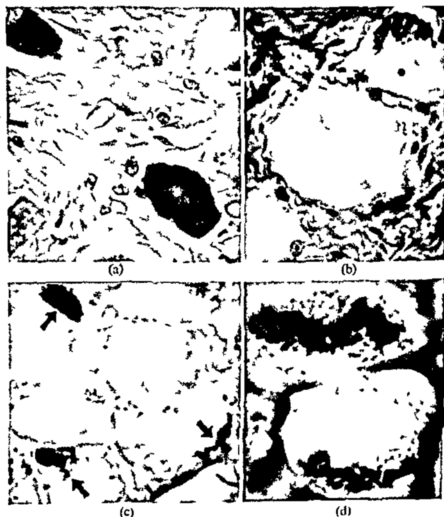
Montagna (1956) has described age changes in the axillary apocrine sweatglands in the human female even by the age of 30 years these are apparent and they take form of dilatation of some segments of tubules and a reduction of the ... lining them from ...

... are dilated In the early fifties the ... the glandular system may become atrophied The normal glandular cells are usually tall and columnar and there are some cytoplasm ... distal borders The ... reaction for ...

... show the presence of glycogen In ... cells of normal glands they may also show a polysacch... glycogen they saliva and which gives a meta... he diastase of ties are the same as those ex... These proper ... A similar reacting substance is also

found in the lumen of such glands Coincidental with these changes in the gland epithelium the associated myo epithelial cells become thin and inconspicuous and seem eventually to disappear In view of these profound ageing changes in the gland itself, it is surprising that the duct shows little or no change Another fact of interest is that considering what has been said earlier about the rejuvenating effect of mitosis, many of these flattened cells show mitotic activity in menopausal subjects

Montagna draws attention to the fact that, although the apocrine glands do not undergo cyclical changes in menstruation or undergo any change during



FIG

pregnancy, they regress at the menopause and that in castrated women they ... changes ... some sort of hormonal ... "secondary ageing"

Other organs

Influence of hormones

Senile changes occur in other organs It is a problem to decide if these changes are inherent in the cells of these organs or whether they are due to the lack of some

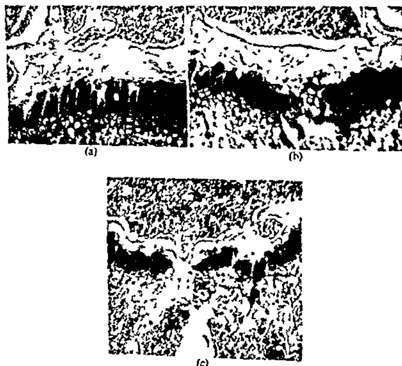


FIG 13 —(a) Growth zone in long bone of a 12 month-old C57 mouse showing regular

external influence such for example, as that of the hormones One might best consider the latter problem first There is no doubt that age changes occur in endocrine glands and these were described in some detail by Cooper (1925) in

her book. She found that the pituitary in older subjects showed an increase in basophil and neutrophil cells, there was also an increase of connective tissue. In old age the three types of granular cell appeared to be even in numbers with perhaps slightly more eosinophils. Very few undifferentiated cells were present and it was surprising that she discovered the presence of a number of tissue mast



(a)



(b)



(c)

FIG. [illegible]

cells. Colloid vesicles were present in the posterior part of the pars anterior in increasing numbers in old age. Another point of interest was the cleft which in the young separates the two epithelial parts of the pituitary body. This cleft is the remains of Rathke's pouch in the embryo and at maturity it becomes obscured. In old age it may open up again and may even contain colloid. In the pars nervosa Cooper found in some cases an increase in the hyaline bodies of Herring and she

also records the occurrence of golden granules (lipo fuscin pigment) between the neuroglial fibres Several more recent papers have dealt with changes in the pituitary

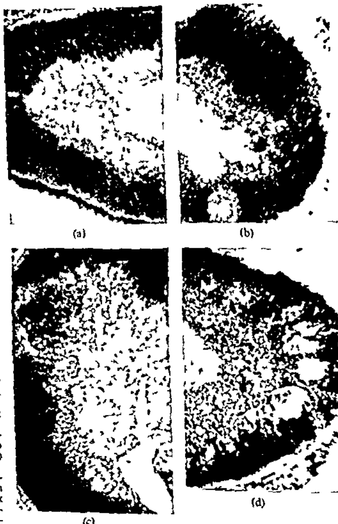


FIG 15 —(a) Adrenal of a 360-day rat showing the distribution and density of lipoid which is about the same as specimens at 90 days of age At first there is very little lipoid but the amount increases up to 90 days. The majority of very old specimens show less lipoid than the young ones which is apparently due to cellular degeneration (b) adrenal of 750-day rat showing somewhat less lipoid than (a) Note a spherical area or nodule The pattern of the cells in this area is distorted due to centrifugal growth resulting in a whorled arrangement of the cell cords The cells within such areas in some specimens contain some stainable lipoid and in other specimens very little or no lipoid. These peculiar areas are usually found in those specimens in which the cortex shows evidence of undergoing cellular degeneration (c) adrenal of a 750-day rat showing two spherical areas (lipoid) nodules with one containing more sudanophilic material than the other The cortex shows an irregular distribution of sudano-

in various animals with age Among them are those of Francis and Mulligan (1949) on the dog and Payne (1952) on the fowl In the fowl ageing changes can be seen in acidophils basophils and chromophobe cells First visible signs of change

appear to be in the mitochondria of the basophils which show enlargement followed by vesicle formation. Fusion of these vesicles to form a single large body was sometimes followed by the death of the cell and the liberation of the large "chondrosphere" into the intercellular spaces About 50 per cent of the basophils may be affected in this way, the rest undergoing nuclear pyknotic changes and appear to become non-functional These changes may be accompanied by a loss of gonadotrophic secretion, for in the male fowl they lead to a decline in production of spermatozoa and eventually degeneration of the testes

Acidophil cells do not appear to undergo the same age changes There are always acidophils with secretory granules, even in old pituitaries, however, their numbers are greatly reduced Chondrospheres similar to those which form in the basophils are present in some acidophils

Colloid and pigment tend to occur also in old pituitaries Profound changes also occur in the pituitary gland of the old hamster (Spagnoli and Charipper, 1955) The changes are more extensive in the males than in the females The cells become loosely packed, there is an increase in degranulation of the cells and pyknotic nuclei occur Vacuolated basophils (more in the male) are seen, colloid-filled acini are present and counts of cells show a decrease in acidophils in males and basophils in females There is an increase in the density of the reticular framework of the pituitary and some disorganization is also present, (*see also* Weiss and Lansing, 1953 for age changes in the mouse pituitary)

The thyroid

In the human thyroid Cooper found a considerable reduction in size with age The vesicles were small and separated from each other by thickened strands of fibrous connective tissue Many vesicles showed no sign of colloid and in others where colloid was present it stained very feebly Cooper believed that old age did not require much activity of the gland so that it regressed However, the regression of the thyroid may be one of the causes of old age

In the ageing fowl Payne also found decreased size of follicles but secretory activity although greatly reduced never ceased completely This was demonstrated by the height of the cells and also by the secretory droplets within the follicular cells In the ageing hamster Spagnoli and Charipper (1955) showed a reduction in colloid in the vesicles, an increase in connective tissue and a breakdown of some of the follicles into scattered groups of epithelial cells Many papers have been published on age changes in both the human and animal thyroids but there is no space to refer to these here It is sufficient to state that there is undoubted evidence of considerable histological change in the senile thyroid, and also evidence of decreased function (Carlson, 1952), for example a reduced amount of iodine in the gland

Adrenal gland

In the adrenal Cooper (1925) recorded an accumulation of connective tissue in the zona reticularis in middle life which became wider and more vascular as age progressed, eventually becoming as wide as the zona fasciculata She also recorded the presence of golden granules in the reticularis cells, which, in the old adrenals filled the cells Bourne (1949) has found quantities of this pigment

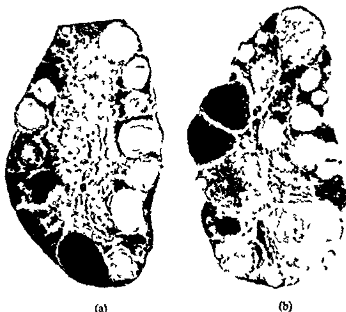


FIG 16—(a) Ovary of C57 mouse aged 3 months treated by carbonyl reagent (b) ovary of C57 mouse aged 8 months Treated by carbonyl reagent

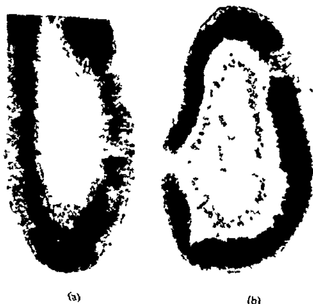


FIG 17—(a) Adrenal of A mouse aged 3 months Treated by carbonyl reagent (b) adrenal of A mouse aged 16 months Treated by carbonyl reagents (*By courtesy of Prof Leblond*)

in the adrenals of opossums and other marsupials Although at the time the age of these was not known precisely it was in the older specimens that they were most common An accumulation of melanin pigment was also found

In old fowls Payne found a considerable reduction in size of the adrenals and this he found to be due partly to shrinkage and partly to degeneration of cells There was cytological evidence of decrease in functional activity although even in the oldest fowls there was not a complete cessation of activity either in cortex or medulla

In the adrenal gland of the rat (Jayne, 1953) found that with advancing age there was an increase in the thickness of the capsule which became more hyaline and



FIG 18—(a) General field of axillary apocrine glands Observe the height of the individual cells From the axilla of a woman 24 years old Ca 150 × (b) Dilated tubule from one on the glands of a woman 61 years old Compare with (a) (*By courtesy of Prof W Montagna*)

more fibrous and in very old rats it showed regions of shrinkage and degeneration After 180 days degenerative cells were observed in all zones of the cortex The mitochondria underwent changes which appeared to result in pigment formation The medullary changes were less than those found in the cortex Atrophic changes have also been recorded in the adrenals following hypophysectomy by a number of authors and it may be that the adrenal changes in old age may be secondary to changes in the pituitary

Age changes in reproductive system

Changes are recorded in the reproductive system with age In the male there is progressive atrophy of the sperm producing elements of the testis, in some cases

only Sertoli cells are left, but in most cases although there is a decrease in the sperm producing cells, spermatogenesis has by no means ceased even in very old

p gmentation

Ovarian changes —Ovarian changes in old age age may be profound According to Masters (1953), "the ovaries of a 70-year old woman are found to be nothing but

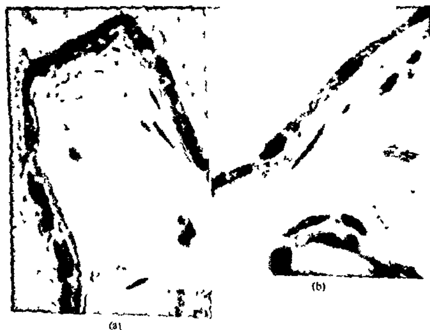


FIG 19 —(a) En thel al cell r
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techn

small fibrous bits of tissue and the uterus is extremely small and fibrous in character All stages between this and the normally functioning ovary of the mature woman can be found It is obvious therefore that at least in woman there is a *profound* drop in sex hormone secre

ex
Th

of other workers (*see also*

Carlson, 1952) has shown that there are considerable morphological changes in the cells of the principal endocrine organs

There is also evidence of decline of function of these glands It becomes of interest therefore to study the changes which take place in the organs of an animal when various endocrine glands are removed and compare them with changes which occur in old age and also to see to what extent treatment of old animals with hormones can ameliorate the changes in the organs and tissues due to this condition *A good deal of work has been carried out in this field but probably the most* complete series of experiments has been conducted by Korenchevsky and others (Korenchevsky and Jones, 1948, Korenchevsky and Paris, 1952)

Korenchevsky and his co-workers studied in great detail the effects of castration in male rats and in man upon the ageing processes In rats the authors described the following age changes, relative hypoplasia of a large variety of organs and considerable compensatory hypertrophy of the cell cytoplasm with little change in the nucleus The result of this is a decreased nucleo-cytoplasmic ratio Multiplication of cells was reduced and there was increased deposition of body fat Nests of metaplastic cells appeared in some animals and became adenoma-like in structure Some mild degeneration of the adrenals and kidneys developed and the parathyroids were more fibrous Relatively normal sex organs and thyroids were found in some old rats Other investigations have also shown atrophy of skeletal muscles and changes in the extra-cellular and intra-cellular water Castration of animals produced changes which, in many cases, were similar to those found in ageing If ageing animals are castrated then changes which are present in both conditions are greatly aggravated Many of the changes shown in *castrated rats are also shown by castrated human beings and some of them resemble* the human old age changes As mentioned earlier, Malaty and Bourne (unpublished work) have demonstrated a decrease in the succinic dehydrogenase reaction in liver, kidney and heart muscle in castrated rats, which would indicate a decreased rate of respiration by these organs A decreased rate of respiration in tissues is also found in old age In this particular case such a finding may be coincidental, *since there are many factors which control respiration of tissues and the* same authors have also found an even greater decrease in this reaction in adrenalectomized animals Nevertheless, the fact that the respiration of tissues does decrease following removal of various glands suggests that decreased secretion from these glands in old age may be concerned in the drop in respiratory rate of old tissues Malaty and Bourne found that treatment of castrated and adrenalectomized animals with male sex hormone or cortical hormones secured a return of succinic dehydrogenase reaction of heart muscle, kidney and liver tissue to normal This adds interest to a consideration of the results of Korenchevsky and his co workers (1953) on the treatment of senescence in male rats with thyroid and adrenal and also with sex hormones The latter point out that in human old age the testes and thyroid might either be well-preserved or they may undergo a certain amount of atrophy and degeneration In the case of rats and men good results with treatment with hormones of these organs could come only if such degeneration were present Since old age can occur even with apparent normal functioning of such glands it would appear that they are not necessarily directly related to the fundamental processes of ageing The use of desoxycorticosterone acetate in



FIG 20 —Electron micrograph of portion of the cytoplasm of a mouse
50 000 This demonstrates the Golg
(P) The pigment granules
that the pigment is derive
(*See also* Fig 21) (*B*) cour

senescent animals in reasonable quantities had little or no stimulating effect on the various organs

In other work on aged female rats the same authors (1950) showed that after treatment with female sex hormones and thyroid hormones some features of ageing were reversed (for example, in some organs the reduction in size, cell multiplication and increased function were returned to normal) However, not all the processes of ageing were reversed and in some cases even harmful results were obtained by use of the hormones, among these were the development of adenoma-like structures in the liver and some of the endocrine glands

Since most of the endocrines are subjected to control by trophic hormones of the pituitary gland, it may be that the changes in these endocrines with ageing are related to fundamental changes in the pituitary. Korenchevsky and Paris (1952) tried the effect of anterior pituitary hormones on ageing female rats They used an anterior pituitary extract which contained gonadotrophic hormones as well as trophic hormones for most of the other endocrines and also for the preputial



FIG 21 —Sympathetic neurone from a man 60 years of age A mass of senility pigment can be seen in the cytoplasm
(*By courtesy of Prof Bronte Gatenby*)

glands, the liver, kidney, spleen and heart The results obtained were a hypertrophy of the liver, spleen and heart, *in other words the hypotrophic* condition of old age had been counteracted by the pituitary hormones When thyroid hormone was injected in association with these anterior pituitary hormones there was a beneficial effect on all the organs (including the endocrines) studied However, although ageing changes were reversed in some organs this anterior pituitary extract did not appear capable of reversing the fundamental ageing processes which were taking place

Hormonal stimulation —This suggests that something much more fundamental is taking place throughout the whole of the body Certain organs respond specifically to certain hormones and it becomes necessary to know whether the age changes shown by these organs can be reversed by treatment with hormones, if not, then the cells of these organs have undergone certain fundamental changes in themselves To some extent the work of Korenchevsky and his co-workers

suggests that specific hormones appear to reverse changes in specific target organs, but we must remember that this work is based partly on comparison of organ weights and to some extent on histological changes and it needs to be repeated on a cellular level using modern cytological and histochemical tools which are available

The question remains as to what extent hormone sensitive tissue in old animals can respond to appropriate hormonal stimulation Masters (1953) records the effects of sex hormone treatment of female patients who were over 60 years of age and who were all at least ten years past the menopause These patients were followed until eleven of them died and autopsy material was obtained from the reproductive organs They found the uterus and cervix increased in size and became comparable in size in this respect with the normal for women between 20 and 40 years The vagina was returned to a state identical in appearance with that seen in the fully functional vagina and reactivation of breast tissue was also obtained Although microscopical sections showed a reactivation of the blood vessels in the ovary the latter d d not show

hand skin is said to r

become more youthful in appearance a

bone cartilage

age in relation to stimulation by hormones They pointed out that the capacity for growth in epiphyseal cartilage declines with age and eventually ceases completely On the other hand articular cartilage remains able to proliferate Thus articular cartilage *at any given age* is in a younger state physiologically speaking than the epiphyseal cartilage So the latter has undergone changes which are in fact irreversible Apart from this however it seems that the majority of cells in the body although going through a process of ageing can still show the ability to respond to appropriate stimulation This applies particularly to reverting post mitotic cells such as those of the liver, which have considerable regenerative power following injury or removal of part of the

and their successive generations vary

reactivity to the various stimuli including those of hormones and organizers and there is thus reason to believe that variation in sensitivity occurs also in old age

It is possible too that age changes in nerve cells might be reversed with hormonal or other stimulation but no form of stimulation will bring back to the brain the cells which have been lost during the age

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occur

changes

brain

senescent animals in reasonable quantities had little or no stimulating effect on the various organs

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The term ' carbonyl" refers to the group >C=O which is characteristic of both aldehydes and ketones A number of reagents have been used for demonstration of carbonyl groups Fuchsin sulphurous acid has been used particularly for demonstration of aldehydes, various other reagents, for example dinitrophenylhydrazine and hydroxynaphthoic acid hydrazide, have been used in an attempt to demonstrate keto groups but their specificity for these groups is doubtful It had been hoped by their use to localize active keto steroids in tissues

There are present in a wide variety of tissues a compound or series of compounds which are soluble in fat solvents and which are called "plasmalogens", these consist essentially of acetal phosphatides Plasmalogen gives no reaction itself with any carbonyl reagent but when the tissue is treated with mercuric chloride or formalin a reaction is obtained due to release of aldehyde groups Although this reaction is granular in a few cases, in most organs it is diffused through the cytoplasm of the cells

Albert and Leblond found that in the gonads and in the accessory sex organs there was very little reaction at birth but with sexual maturity a very strong reaction was obtained This was followed by a gradual decrease of the reaction with advancing age In such organs as the kidney and liver the cells of all animals showed a strong reaction but this, too, gradually decreased with age A similar result was obtained from the adrenal and it was associated with some degeneration of the cortical zone

In hypophysectomized animals there was a reduction of the reaction in the gonads and the accessory sex organs This work [illegible] some extent under en[illegible] metabolism of plasm[illegible] reactions It may be t[illegible] decrease of this reaction in old age is due primarily to senescence of the pituitary

We have thus seen that there are changes in cell membranes and chemical (particularly enzymic) changes in cells with age We do not yet know whether these [illegible] some of them are under endocrine control [illegible] from this review, and that is there is no [illegible] complex phenomenon which in metazoa appears to result from a series of processes which take place simultaneously throughout the body and no one process can be properly regarded as being due to any of the others

The problems briefly discussed in this chapter indicate what a complex biological problem ageing has proved to be We are still a long way from understanding the mechanism which winds cellular and organismal life to a peak and then slowly lets it run down but it is only by the biological and cellular approach that it will be possible to obtain some sort of understanding of the factors which govern this process

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— and Malaty, H A (1953) *J Physiol*, 122, 178

Other factors in ageing

In part, the senile changes in cells may be due to some intrinsic property of protoplasm and/or in part to certain chemical influences which may be stimulating (for example, hormonal) or inhibitory (for example, *metabolic by-products*) Euler (1951) suggests that "the high molecular governing hormones of the body undergo a fall in chemical energy and according to a general thermo dynamic law they have the tendency to increase their entropy After the growth period the body cannot compensate for the loss of growth hormone by synthesis" The result of this is a decrease of the governing hormones which is in effect the primary cause of senility However, Euler's comments are meaningless to the present author

Ageing of cells may be due to membrane changes Lansing (1942) has obtained results which suggest an accumulation of calcium at the membranes of old cells and following treatment which, he claims, removes such calcium, has been able to prolong the lives of rotifers We do not know of course what the other effects of his treatment might be even if it does remove this substance from all membranes Calcium has been found to be increased in amount in a variety of old human tissues, for example, brain, sclera, arteries, elastic tissues (Simms and Stolman, 1937, Lansing and his colleagues 1949) using radio-calcium have shown that in *old livers the calcium is more firmly bound than in the young liver They state that* there is some evidence that some at least of the intracellular calcium is associated with a ribonucleoprotein complex which is situated at or near the cell surface Also Thoenes (1925) has claimed that water was present in greater proportions in the protoplasmic colloids in the tissues of young animals than in old animals and that in the former it is more firmly bound An interesting point is that Weber (1931) showed that there was a difference in viscosity between old and young cells of different ages In cells which are young the cytoplasm is relatively fluid and the viscosity gradually increases to middle life and then the cytoplasm becomes progressively more fluid with age

That the permeability of membranes is altered in old age is shown by a number of workers (*see* Lansing, 1947) It is not always altered in the same direction for all substances for instance in Spirogyra old cells were found to be more permeable to alcohol but less to urea (Nordenson, 1919) Herzfeld and Kluger showed a long time ago (1913) that with age there was an increase of protein at the surfaces of the cells and that this interfered with the normal free exchange across the membrane *A number of chemical* and histochemical changes have been recorded in aged tissu ... of the esterolytic enzy ... then decrease again in ... age There is also a decrease in adenosine triphosphate and inorganic phosphates Cahane (1932) ... water content in the aged lens ... livers is greatly reduced in old ... have difficulty in synthesizing phosphoric esters

One interesting histochemical study of ageing tissues which has been recorded is that of Albert and Leblond (1949) on "Age changes revealed by carbonyl reagents in tissue".

BIBLIOGRAPHY AND REFERENCES

The term "carbonyl" refers to the group $>C=O$ which is characteristic of both aldehydes and ketones A number of reagents have been used for demonstration of carbonyl groups Fuchsin sulphurous acid has been used particularly for demonstration of aldehydes, various other reagents, for example dinitrophenylhydrazine and hydroxynaphthoic acid hydrazide, have been used in an attempt to demonstrate keto groups but their specificity for these groups is doubt-

consist essentially of acetal phosphatides Plasmalogen gives no reaction itself with any carbonyl reagent but when the tissue is treated with mercuric chloride or formalin a reaction is obtained due to release of aldehyde groups Although this reaction is granular in a few cases in most organs it is diffused through the cytoplasm of the cells

Albert and Leblond found that in the gonads and in the accessory sex organs there was very little reaction at birth but with sexual maturity a very strong reaction was obtained This was followed by a gradual decrease of the reaction with advancing age In such organs as the kidney and liver the cells of all animals showed a strong reaction but this, too, gradually decreased with age A similar result was obtained from the adrenal and it was associated with some degeneration of the cortical zone

In hypophysectomized animals there was a reduction of the reaction in the gonads and the accessory sex organs This work suggests that the aldehyde is to some extent under endocrine control and the authors consider that it indicates a metabolism of plasmalogen resulting in the provision of aldehydes for cellular reactions It may be that the decrease of this reaction in old age is due primarily to senescence of the pituitary

We have thus seen that there are changes in cell membranes and chemical (particularly enzymic) changes in cells with age We do not yet know whether these are intrinsic or secondary but at least some of them are under endocrine control

One conclusion becomes quite clear from this review, and that is there is no single "cause of ageing" Ageing is a complex phenomenon which in metazoa appears to result from a series of processes which take place simultaneously throughout the body and no one process can be properly regarded as being due to any of the others

The problems briefly discussed in this chapter indicate what a complex biological problem ageing has proved to be We are still a long way from understanding the mechanism which winds cellular and organismal life to a peak and then slowly lets it run down but it is only by the biological and cellular approach that it will be possible to obtain some sort of understanding of the factors which govern this process

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Other factors in ageing

In part, the senile changes in cells may be due to some intrinsic property of protoplasm and/or in part to certain chemical influences which may be stimulating (for example, hormonal) or inhibitory (for example, metabolic by-products) Euler (1951) suggests that "the high molecular governing hormones of the body undergo a fall in chemical energy and according to a general thermo-dynamic law they have the tendency to increase their entropy. After the growth period the body cannot compensate for the loss of growth hormone by synthesis" The result of this is a decrease of the governing hormones which is in effect the primary cause of senility. However, Euler's comments are meaningless to the present author

Ageing of cells may be due to membrane changes. Lansing (1942) has obtained results which suggest an accumulation of calcium at the membranes of old cells and following treatment which, he claims, removes such calcium, has been able to prolong the lives of rotifers We do not know of course what the other effects of his treatment might be even if it does remove this substance from all membranes Calcium has been found to be increased in amount in a variety of old human tissues, for example, brain, sclera, arteries, elastic tissues (Simms and Stolman 1937 Lansing and his colleagues 1949) using radio-calcium have shown that in old livers the calcium is more firmly bound than in the young liver They state that there is some evidence that some at least of the intracellular calcium is associated with a ribonucleoprotein complex which is situated at or near the cell surface Also Thoenes (1925) has claimed that water was present in greater proportions in the protoplasmic colloids in the tissues of young animals than in old animals and that in the former it is more firmly bound An interesting point is that Weber (1931) showed that there was a difference in viscosity between old and young cells of different ages In cells which are young the cytoplasm is relatively fluid and the viscosity gradually increases to middle life and then the cytoplasm becomes progressively more fluid with age

That the permeability of membranes is altered in old age is shown by a number of workers (*see* Lansing, 1947) It is not always altered in the same direction for all substances for instance in Spirogyra old cells were found to be more permeable to alcohol but less to urea (Nordenson, 1919) Herzfeld and Kluger showed a long time ago (1913) that with age there was an increase of protein at the surfaces of the cells and that this interfered with the normal free exchange across the membrane A number of chemical and histochemical changes have been recorded in aged tissues We cannot discuss them all but mention might be made of the esterolytic enzymes which increase their concentration to middle age and then decrease again in old age (Sekla, 1928) The arginase of livers decreases with age There is also a decrease in adenosine triphosphate and inorganic phosphates Cahane (1932) described an increase in cholesterol and decrease in water content in the aged lens and the high ascorbic acid content of adrenals and livers is greatly reduced in old animals, and Lansing (1952) states that old tissues have difficulty in synthesizing phosphoric esters

One interesting histochemical study of ageing tissues which has been recorded is that of Albert and Leblond (1949) on "Age changes revealed by carbonyl reagents in tissue".

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CHAPTER 3

NORMAL VALUES AND THE INTERPRETATION OF BIOCHEMICAL DATA IN THE ELDERLY

ARTHUR JORDAN

In clinical medicine, biochemical data most commonly take the form of quantitative results of analyses carried out on blood or urine from a particular patient as a help in diagnosis or in the control of treatment. It is necessary to know whether such a result falls within the normal limits for the appropriate age and sex. Early in the development of chemical pathology it was realized that the range of normal values for particular investigations was not identical in children and in adults, and it is now recognized that differences exist also between young and elderly adults.

Before discussing "normal" values for different investigations in old age, some points need to be considered.

Comparison of analytical methods

Many analytical methods are not specific for the substance which it is sought to determine. For instance, the "blood-sugar" determination as carried out in most laboratories is a determination of the reducing power of the blood under the particular conditions of the method, the greater part of this reduction is normally due to glucose, but, because the part played by other reducing substances depends upon the conditions, each of the numerous blood-sugar methods has its own "normal" values. Published results of any analyses—not only the blood sugar—must give a reference to the method of analysis used. Comparisons of results obtained by different methods are of little value unless previously the two methods have been compared on the same material.

Experimental error

The experimental error in some laboratories is much greater than the clinicians realize or the pathologist would care to admit, so great indeed that quantitative results may be of questionable value. The use of careful controls is often neglected, the pathologist tending to rely on his impression that satisfactory results are being obtained. The extent to which supposedly reliable laboratories can differ from one another in their results for particular investigations has been repeatedly demonstrated, for example by Belk and Sunderman (1947, 1948) and by Wootton and King (1953). Laboratories must maintain internal checks, in addition, it is possible to obtain samples of blood or plasma of known composition for the purpose of further checking. No laboratory can afford to neglect proper and adequate controls.

Ways of expressing "normal values"

The way the "normal" values for a particular investigation are expressed has often been unsatisfactory A mean value is obviously inadequate and usually a range is quoted If the range is obtained by including all the values from the "normal" subjects, the greater the number of "normal" subjects studied, the wider such a range tends to become because, inevitably, a small number of

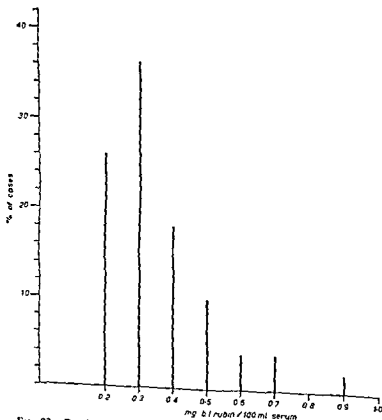


FIG 22 —Res lts of

it is abnormal What is required is some nd ... ormal values, the greater the chance that
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will comprise about 95 per cent of the "normal" values This is not infrequently done but is only justifiable if the values about the mean are distributed in accordance with what the statisticians call the normal curve, which is symmetrical Many of the commoner determinations have an unsymmetrical or skew distribution (Wootton, King and Smith, 1951) This is illustrated in Fig 22, which is adapted from a diagram given by Wootton and his fellow-workers and shows the results

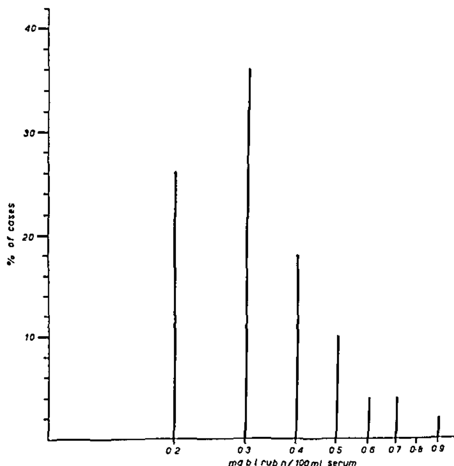


Fig 23.—Results shown in Fig 22 replotted with the logarithm of the serum bilirubin as abscissa

of the serum bilirubin determination in 100 normal people To quote, as the normal range, the mean plus or minus twice the standard deviation in such a case is theoretically wrong in practice the extent of the inaccuracy will depend upon the extent of the lack of symmetry

result with a normal range, it is desirable that the range should be as accurate as

possible If the values of Fig 22 are replotted using the same ordinate, but with the logarithm of the serum bilirubin as abscissa, a much more symmetrical pattern results (Fig 23) By using a logarithmic scale for the bilirubin values a normal curve (in the statistical sense) has been produced The distribution is said to be lognormal With the values plotted in Figs 22 and 23, the calculated range which will contain 95 per cent of the values extends from 0 05 to 0 66 milligram per 100 millilitres if the distribution be treated as a normal one, although in fact no values of less than 0 2 milligram per 100 millilitres were found, calculated as a lognormal distribution, the corresponding figures are 0 18 to 0 60 milligram per 100 millilitres which seems a better approximation to the truth The difference between

it as within the limits which contain 95 per cent of normal values, whereas the values derived from the lognormal distribution reveal it as abnormal

Wootton and his colleagues have devised a better method of expressing the normal range They quote first, the upper and lower values which embrace 80 per cent of the results obtained on "normal" persons, to the exclusion of the highest 10 per cent and the lowest 10 per cent of results, and secondly, the upper and lower values which embrace 98 per cent of the "normal" results to the exclusion of the highest 1 per cent and the lowest 1 per cent This procedure does not involve any theoretical assumptions, and the ranges can be obtained by simple inspection of the data If the values are distributed according to the normal symmetrical curve

colleagues suggest that results within the 80 per cent range should be accepted as normal, values lying outside the 80 per cent limits but within the 98 per cent limits should be regarded with suspicion, and values lying outside the 98 per cent range should be considered to be abnormal In this chapter, the range which embraces the middle 80 per cent of normal values will be quoted whenever possible Unfortunately, in many cases, insufficient data are available for this to be done

Defining a "normal" person

What is meant by a "normal" person remains to be discussed The late Professor Ryle (1947) emphasized that no two persons being exactly the same, "normal" must mean within the range of "normal" variability In the case of children or younger adults a "normal" is usually accepted as one who ha

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values c [illegible] established Consequently subjects tend to be chosen as "normal" in respect of a particular investigation because they suffer from no cond known to cause that particular

supposes a prev

under consideration In practice, this amounts to accepting the values yielded by old people after exclusion of extreme results and of results from persons suffering from conditions which, in younger persons, are known to influence the particular determination

Finding subjects for investigation

When a definition of what is to be regarded as "normal" has been established, the problem of finding the subjects arises Hospital patients provide the easiest source but are more prone to have some condition which will affect the result, in any case they are not a representative group Nor are old people in homes or institutions completely representative, certain factors must have operated to lead them into such an institution and they constitute a selected population The best cross-section is provided by old people living in their own homes, this group is the most difficult to recruit as volunteers for the establishment of normal values

When the technical methods are efficient, and satisfactory volunteers are available, other difficulties arise The effects of food on the blood-sugar level and of rest in connexion with the basal metabolic rate are well-known, and posture has been shown to affect the serum protein level (Dyson and Plaut, 1943, Whitehead, Prior and Barrowcliff, 1954) The antecedent diet affects the serum cholesterol level (Hildreth, Mellinkoff, Blair and Hildreth, 1951, Keys, 1952a), the glucose tolerance curve (McClellan and Wardlaw, 1932) and will influence, through its vitamin content, the actual levels of the vitamins themselves and of other metabolites which are known to be closely linked to vitamin intake, such as the pyruvic acid level It is probable that there are other factors

These factors (diet, for instance) are often important in old age It is not uncommon to find old people subsisting on diets which are poor by comparison with those taken by younger members of the same social class, it would be easy to attribute to age, changes in the blood or urine chemistry which were occasioned by diet Again, the aged are usually less active than younger people and this may have some effects

It is recognized that, at the same age, the composition of the blood and urine differs in the two sexes It is to be regretted that, in the past, some authors have published results without indicating the sexes of the individuals studied

It is apparent that many things need to be borne in mind when the result of a quantitative analysis on an old person has to be interpreted One general rule can be stated, no significance should be attached to small differences

Metabolism

The only direct measurement of the rate of metabolism which is carried out in clinical medicine is the determination of the basal metabolic rate, in which the rate of oxygen consumption of the body is measured and the rate of heat production of the whole body is calculated therefrom The rate of heat production is increased by food and by activity and therefore all determinations are carried out on the resting subject in the post-absorptive state (that is, 12 hours after food) and these are regarded as basal conditions

The production of heat varies with body size and the most satisfactory expression

[illegible] which gives the calories produced per square metre of body [illegible] The body- [illegible] of Du Bois

With advancing years the metabolic processes [illegible] For many years the values of Aub and Du Bois (1917) as modified by Means and Woodwell (1921) have been widely used in Great Britain as the standard of metabolism These values were modified by Boothby and his colleagues, on the basis of a very large series of determinations (Boothby, Berkson and Dunn 1936) and the [illegible] noted All these values were obtained in the [illegible] countries (Du Bois, [illegible] 52) derived from the [illegible]

ought to be considered Diet, especially the protein intake, can influence the basal metabolic rate (Benedict, Miles Roth and Smith, 1919) This factor may have some importance in the aged who often take protein foods sparingly

TABLE I

MEAN HEAT OUTPUT IN RELATION TO AGE AND SEX—REPRESENTATIVE VALUES

Males

	Boothby and others		Robertson and Reid	
Age (years)	*Mean*	*Range*	*Mean*	*Range*
20	41 6	36 6–46 6	38 4	37 6–44 3
40	38 3	33 7–42 9	35 5	30 5–40 5
50	37 0	32 4–41 6	33 9	28 9–38 9
60	35 7	31 1–40 3	33 2	28 2 38 2
70	34 5	29 9–39 1	32 5	27 5–37 5

Females

	Boothby and others		Robertson and Reid	
Age (years)	*Mean*	*Range*	*Mean*	*Range*
20	36 3	31 3–41 3	34 3	29 5–39 1
40	35 5	31 1 39 9	32 6	27 8 37 5
50	34 4	30 0–38 8	32 0	27 2–36 9
60	32 8	28 4–37 2	31 3	26 6–36 2
70	32 2	27 8 36 6	30 8	26 0–35 6

The va[illegible]

Of the standards in general use, those of Boothby, Berkson and Dunn (1936) give high, and those of Robertson and Reid (1952) low expected values for a given age and sex Representative ranges of both are set out in Table I Complete tables are necessary if basal metabolic rate determinations are to be made, the values quoted serve only to illustrate the effects of age and sex and the differences between the values of Boothby and his fellow workers and of Robertson and Reid The values of Aub and Du Bois (1917) for old age were obtained on six old men (one of whom they omitted from their series) and yield results a little higher than those of Boothby and others

Effects of nutrition

Pyruvic acid and thiamine —Some constituents of the blood which are clinically of diagnostic importance, depend directly, but not necessarily only, upon the diet Pyruvic acid and some of the vitamins provide examples Kirk and Chieffi (1949) found that the blood thiamine (vitamin B_1, aneurin) level declined slowly with age, whereas the pyruvic acid level was constant The significance of the decline in the blood thiamine level is not clear either the diet contained less, or absorption was impaired, or the ability of the body to store the vitamin was reduced in the older age groups From inspection of their data, it is apparent that both thiamine and pyruvic acid have frequency distributions which are lognormal From Kirk and Chieffi's results for normal old people aged 60 to 79 years the middle 80 per cent of fasting blood thiamine values lie between 2 0 and 4 8 micrograms per 100 millilitres, the mean being 3 4 micrograms per 100 millilitres For the age group 20 to 39 years the mean was 3 8 micrograms per 100 millilitres The 80 per cent range derived from their results for the blood pyruvic acid (0 61–1 60 milligrams per 100 millilitres) goes higher than many authorities would accept most authors regard 1 1 to 1 2 milligram per 100 millilitres as the upper limit of the normal range of the fasting blood pyruvic acid In the clinical diagnosis of thiamine deficiency, the most useful investigation is probably a study of the pyruvic acid levels following administration of glucose to the fasting subject (Joiner, McArdle and Thompson, 1950)

Severe deficiency of vitamin C —Severe deficiency of ascorbic acid (vitamin C) is most simply diagnosed by determining the ascorbic acid content of the white cell layer of the blood (Vitamin C Sub-committee, 1948) A value of less than 2 milligrams per 100 grammes may be taken to mean a severe deficiency (that is,

ascorbic acid content of whole blood tends to fall with advancing years

Vitamin A and carotene —The relationship of the serum levels of vitamin A and carotene to age has been studied by Rafsky, Newman and Jolliffe (1947), Kirk and Chieffi (1948), and Yiengst and Shock (1949) The findings of these authors are not all in agreement Rafsky and his colleagues came to the conclusion that there was a fall in the mean vitamin A and carotene levels with age whereas the other authors did not Yiengst and Shock found a significant correlation between

the vitamin A and the carotene level in serum which Rafsky and his colleagues did not find All three groups of authors agreed in finding a very wide variation in [illegible]

from 18 to 130 micrograms per 100 [illegible]
from 6 to 78 micrograms per 100 millilitres, these values were obtained in people [illegible] determinations must be

(1949) found that there was a tendency for oral administration of vitamin A to yield lower maximum values after a slightly longer delay in older people as compared with younger people This may be related to the finding of Becker, Meyer and Necheles (1950) that the rate of fat absorption tends to decrease with advancing years, if the fat is absorbed more slowly, the fat soluble vitamins might well be absorbed more slowly

Thyroid gland

Two methods of estimating the activity of the thyroid gland are in common use (1) determination of the basal metabolic rate, which has been discussed already, and (2) measurement of the uptake of radioactive iodine by the gland This latter is still a procedure carried out only in special centres The uptake of radioactive iodine may decline with advancing years (Ackermann and Iversen 1953)

Urinary 17 ketosteroids

The excretion of hormones in the urine has been studied extensively in the hope of [illegible]

[illegible] carbons Some of the 17 ketosteroids present in the urine are the hormones produced by the endocrine gland concerned, others are metabolites of such hormones In the urine the 17 ketosteroids are in the conjugated form as glucuronides and as sulphates the analytical methods which have been evolved all demand that the hormones shall be free and not conjugated [illegible]

[illegible] by producing artefacts and in various other ways Consequently the results of the determination depend upon the particular conditions of the hydrolysis The results from one particular laboratory done by a given method should be consistent among themselves but a good deal of caution is necessary when results from one laboratory are to be compared with those from another laboratory Methods of hydrolysis have been reviewed by Lieberman, Mond and Smyles (1954)

The 17 ketosteroids excreted in the urine by men are derived partly from the adrenal cortex partly from the testis In women the adrenal cortex is usually stated to be the sole source The daily excretion of 17 [illegible]
lower in [illegible]
years (H[illegible]

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of increased activity of the adrenal cortex, the determination of the total 17-ketosteroid output seems to be reliable, but it is less sensitive as an index of depressed activity This is due, in part at least, to the wide variation of the normal range and to the fact that in the male, (and perhaps in the female), the adrenal cortex is not the only source of the hormones If the output of the individual 17-ketosteroids were easily determined, some of the difficulties might be resolved Despite its limitations, the investigation is valuable

Urinary corticoids

Apart from the 17-ketosteroids, other steroid hormones produced by the adrenal cortex appear in the urine, they are usually termed corticoids The assay of the urinary corticoids has been attempted in various ways such as determination of the reducing power, conversion to formaldehyde and determination thereof, or by determining the "17 ketogenic steroids" [illegible]

195 [illegible]

of t[illegible]

the assay of the urinary 17-ketosteroids before and after oxidation will give therefore a measure of the hormones The steroids assayed in this way are known as the 17-ketogenic steroids The great advantage of Norymberski's method lies in the fact that the corticoids can be oxidized in the urine before hydrolysis, corticoids are damaged by acid hydrolysis more readily than ketosteroids Other methods of determining corticoids require acid hydrolysis as the first step and result in considerable losses

Changes in the 17 ketogenic steroid output are usually taken to reflect directly changes in the activity of the adrenal cortex General asthenia with a reduced basal metabolic rate and a tendency to increased pigmentation are common to old age and to adrenal cortical insufficiency, and a decline in adrenal cortical funct[illegible] ction of the 17-ketogenic steroids in the old [illegible] From the age of 18 years onwards there [illegible] 7-ketogenic steroids with age, there is no significant difference in the output of the two sexes Of the values in normal people 80 per ce[illegible] ams a day and 98 per cent [illegible] ie output has a lognormal

Other hormones

Other hormone assays are carried out Assays of hormones in blood are still in the experimental stage In urine, a number of assays [illegible]

Carbohydrate metabolism and glycosuria

For a long time it has been generally accepted that with advancing years there is a loss of carbohydrate tolerance This means that the amount of carbohydrate that the body can deal with in a given time is reduced, it does not necessarily

1949, Kowalewski, 1950, McGavack, 1951, Huis in't Veld and Dingemanse, 1952 Levell, Mitchell, Paine and Jordan, 1956) In these different studies, insufficient attention has been paid to the possible influence of other factors which might well play a role in causing a difference between the results obtained in young adults and in old people For instance, starvation has been shown to cause a decrease of 50 per cent in the 17-ketosteroid excretion (Landau and his colleagues, 1948), and these authors found that biological assays of the androgenic activity of the urines from the males showed a *corresponding fall The depressing effect of diet restriction* on the male libido is well recognized (Benedict and his colleagues, 1919, Jacobs, 1948), it is presumably connected with the diminished production of androgens Hamilton and Hamilton (1948) found that the total urinary excretion of neutral 17-ketosteroids by men serving prison sentences was appreciably lower than that by men on the hospital and laboratory staffs, the differences might be due to diet or could be due to the lesser activity of the prisoners, they found no correlation between time already spent in prison and the total 17-ketosteroid output That activity may play a part is suggested by the observation that the rate of output of 17-ketosteroids is lowest during sleep, and is highest from 7 a m to 11 a m (Pincus, Romanoff and Carlo, 1948)

TABLE II

Daily Output of 17 Ketosteroids in the Urine in Relation to Age

Age (years)	*Levell and his colleagues (80 per cent range)*	*Hamburger (97–98 per cent range)*
	Men	
20	8–21	6–20
40	8–18	6–22
50	7–16	5–18
60	5–14	3–14
70	4–12	2–10
80	3–10	2–8
	Women	
20	6–17	4–16
40	6–15	3–9
50	5–13	3–9
60	4–12	2–8
70	4–10	1–7
80	3–9	1–6

The ranges given are those of Levell and his colleagues (1955) which comprises the middle 80 per cent of results on normal people and of Hamburger (1948) which comprises the middle 97—98 per cent of results on normal people The figures are in milligrams per 24 hours

Unless a particular laboratory has made an extensive study of the normal values yielded by the particular method used, it is wise to accept very wide limits for the normal range at any age In Table II are set out some ranges As an indicator

findings have obtained in renal glycosuria The full significance of this phenomenon in respect of the excretion of glucose is not yet understood.

Renal function

[illegible]

thirds the number present in a young adult. The effect of this diminution might be expected to resemble that resulting from excision of a part of the kidney. Many years ago Rose Bradford showed that the excision of two thirds or more of the total kidney tissue in the dog increased the output of urine, but the maximum specific gravity which could be achieved was lowered (Bradford, 1899) These findings have been confirmed by others, and similar observations were made on rats by Chanutin and Ferris (1932) Because the number of glomeruli is diminished and the volume of urine is increased, each surviving nephron (glomerulus and annexed tubule) must be producing more urine The experiments of Platt, Roscoe and Smith (1952), working with rats, showed that the amount of glomerular filtrate [illegible]

[illegible] ... filtration rate) was 124 4 millilitres per minute for men in the age range 20 to 40 years and 90 8 millilitres per minute at the age of 65 years This is a fall of 27 per cent Similar values result from the work of Shock (1946), Olbrich and his colleagues (1950), Miller, McDonald and Shock (1952) and Mitchell and Valk (1953) This fall of 27 per cent may be compared with Moore's finding of a loss of from 33 per cent to 50 per cent of the glomeruli between th[illegible]

[illegible] ... of the [illegible] ...

[illegible] ... 020 for men aged 60

The diodone clearance in the healthy young kidney provides [illegible]
the effective renal [illegible]
it has been [illegible]
rate which [illegible]
rate (Shock, [illegible]
Mitchell and [illegible]

Tubular function has been studied in relation to the re-absorption of glucose (T_{MG}), the excretion of diodone (T_{MD}) and the excretion of para-amino-hippuric

mean a greater liability to diabetes mellitus, for this disease comprises more than a simple diminution of the ability to metabolize carbohydrate. The changes reported are a higher fasting blood-sugar level, and, in the glucose tolerance test, a higher peak and a slower return to normal (Spence, 1921, Hale-White and Payne, 1926, Romcke, 1931, Marshall, 1931, Hofstatter, Sonnenberg and Kountz, 1945, Chesrow and Bleyer, 1954). Doubt was thrown on the importance of these findings by the work of Horvath, Wisotsky and Corwin (1947) who found that repeated glucose tolerance tests in old men gave the most variable results, some of the subjects who furnished a diabetic-like curve on one occasion having produced an essentially normal curve a few weeks earlier or later. These findings have neither been confirmed nor disproved at all exhaustively, but there is other evidence to support the view that the glucose tolerance test can vary in the same subject to a greater extent than is often admitted.

The normal limits of an oral glucose tolerance test after 50 grammes glucose carried out on capillary blood can be stated as follows:

Fasting blood sugar: 70—110 milligrams per 100 millilitres.
Peak: reached up to 1 hour after glucose with a blood sugar of up to 220 milligrams per 100 millilitres.
Fall of the blood sugar: 1½ hours after glucose to less than 150 milligrams per 100 millilitres, 2 hours after glucose to less than 120 milligrams per 100 millilitres.

If venous blood be used, all the values will tend to be somewhat lower. In the case of the aged the fasting blood sugar should not be over 110 milligrams per 100 millilitres but the peak may be reached later and the return of the blood sugar to normal may occur more slowly.

Other studies have borne on the intravenous glucose tolerance test, either 25 grammes of glucose or 0.33 gramme of glucose per kilogram of body weight being common test doses. Both Smith and Shock (1949) and Schneeberg and Finestone (1952) found that the return to normal in older subjects occurred more slowly.

The antecedent diet, especially the carbohydrate content thereof, determines the shape of the glucose tolerance curve to a considerable extent and much of the work on carbohydrate tolerance in old age has neglected this important factor. The diagnosis of frank diabetes mellitus of any severity does not, as a rule, demand a glucose tolerance curve. If a tolerance is to be carried out, it is desirable that the subject should be on a diet containing 400 grammes carbohydrate a day for 5 or 6 days beforehand.

Glycosuria occurs because all the glucose present in the glomerular filtrate is not re-absorbed in the tubules. Miller, McDonald and Shock (1952) found that the ability of the renal tubule to re-absorb glucose falls with increasing age but that the glomerular filtration rate falls at a proportionately similar rate. As the amount of glucose presented to the tubules will be the product of the plasma glucose concentration and the glomerular filtration rate, it follows that the incidence of renal glycosuria in normal old people should be similar to that in younger age groups, the "renal threshold for glucose" should remain unchanged in old age. This is what is found in practice. However, Robertson and Gray (1953) found that in some cases of diabetes mellitus with lowered renal thresholds, the apparent tubular re-absorption of glucose rose progressively with a rising blood sugar. Similar

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findings have obtained in renal glycosuria The full significance of this phenomenon in respect of the excretion of glucose is not yet understood.

Renal function

Renal function declines with advancing years Moore (1931) produced evidence that ageing leads to a diminution in the number of glomeruli. For example, in the seventh decade of life, the number of glomeruli is usually about one-half to two-thirds the number present in a young adult The effect of this diminution might be expected to resemble that resulting from excision of a part of the kidney. Many years ago Rose Bradford showed that the excision of two-thirds or more of the total kidney tissue in the dog increased the output of urine, but the maximum specific gravity which could be achieved was lowered (Bradford, 1899). These findings have been confirmed by others, and similar observations were made on rats by Chanutin and Ferris (1932) Because the number of glomeruli is diminished and the volume of urine is increased, each surviving nephron (glomerulus and annexed tubule) must be producing more urine The experiments of Platt, Roscoe and Smith (1952), working with rats, showed that the amount of glomerular filtrate which could be produced by a given amount of renal tissue rose by about 40 per cent

... filtration rate) was 124·4 millilitres per minute for men in the age range 20 to 40 *years and* 90·8 millilitres per minute at the age of 65 years This is a fall of 27 per cent Similar values result from the ...
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The diodone clearance in the healthy young kidney provides a good mea...
the effective renal plasma flo...
it
rat ... holding for the glomerular filtration
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Tubular function has been studied in relation to the re-absorption of glucose (T_{MG}), the excretion of diodone (T_{MD}) and the excretion of para amino-hippuric

acid ($T_{M_{PAH}}$), and appears to decline with age at a rate proportionately similar to that which holds good for the glomerular filtration rate (Davies and Shock, 1950, Olbrich and his colleagues, 1950, Miller, McDonald and Shock, 1952 Mitchell and Valk, 1953)

On the face of it, if the glomerular filtration rate diminishes with age to the same proportionate extent as tubular function, there is no reason why, with advancing years, the kidney should lose any of its power to produce a concentrated urine Nevertheless, some loss of this power does occur "Osmotic diuresis" results from diminished re-absorption of water, about which our knowledge is far from complete The view that renal excretion is a simple question of filtration and re-absorption has been criticized, both in respect of water excretion and in respect of other substances, and a three-component system of renal excretion—filtration, re-absorption and secretion—has been put forward (Barclay, 1949, Brodsky and Rapoport, 1951, Platt, 1952)

Renal function tests

For clinical purpose, renal function is studied by various investigations such as concentration or water elimination tests, the urea concentration test of McLean and de Wesselow, determination of the blood urea level, the phenolsulphonephthalein test, and the urea clearance test of Van Slyke

Concentration tests—Concentration tests will give apparently impaired results in old age and due allowance must be made Water elimination tests, although traditionally used for testing renal function, are so much influenced by the adrenal cortex as to be of doubtful value

Urea concentration test—The results of the urea concentration test of McLean and de Wesselow, are influenced by "osmotic diuresis", the range of normality usually accepted would dismiss many old people as abnormal Renbourn and Ellison (1952) found that 17 out of 40 individuals aged 70 to 90 years were unable to achieve a concentration of 2 0 grammes per 100 millilitres of urea in the urine

Phenolsulphonephthalein test—The phenolsulphonephthalein (phenol red) test is influenced by a number of factors which are little understood The results of the test are very variable and the real value unascertained

Blood urea—The blood urea is a valuable, but somewhat rough, measure of renal function It is influenced by the diet (Wordley, 1920 Addis and his colleagues, 1947, Kountz and his colleagues, 1953) It is perhaps influenced by race (compare the figures of MacKay and MacKay, 1927, Phillips and Kenney, 1952, and Gokhale, 1941), but the differences may be due to variations in the quality and the quantity of the food taken Many methods of determining the blood urea are in use and yield results which are far from comparable

The blood urea rises with advancing years (Lewis and Alving, 1938 Renbourn and Ellison, 1952) Renbourn and Ellison commented that the blood urea is much more variable in the old than in the young, in the old it may vary by more than 20 milligrams per 100 millilitres when determined on different days for the same individual The blood urea has a lognormal distribution (Wootton and his colleagues, 1951)

In Table III are shown some values of the blood urea in relation to age The range of variation is considerable

TABLE III

BLOOD UREA OF NORMAL SUBJECTS IN RELATION TO AGE

Age (years)	Renbourn and Ellison*		Lewis and Alving†	
	Mean	80 per cent range	Mean	80 per cent range
20–25	28 1	19–37		
40			25 8	15–37
60			30 6	19–42
80			35 4	24–47
60–104	50 2	30–71		

All values in milligrams per 100 millilitres The 80 per cent range comprises the middle 80 per cent of results on normals.
*British males and females Differences between the sexes not statistically significant (Renbourn and Ellison, 1952)
†North American males (Lewis and Alving 1938)

Urea clearance test

The [illegible]

[illegible] and although the blood urea level varies with the protein intake, a relatively large proportionate change in the intake causes a smaller *proportionate* change in the blood urea

TABLE IV

EFFECT OF AGE ON THE UREA CLEARANCE IN NORMAL NORTH AMERICAN WHITE ADULT MALES (*Lewis and Alving*, 1938)

Age (years)	Proportion of average normal (per cent)
40	100 2
60	71 9
80	63 6

Average normal for maximum clearance 75 millilitres per minute for standard clearance 54 millilitres per minute (Austin Stillman and Van Slyke 1921)

The urea clearance is believed to diminish [illegible]

[illegible]

Determinations of the urea clearance [illegible] to age are set out in Table IV

[illegible]

Gokhale (1941) for Indians in Bombay and of Kenney (1954) for West African negroes.

The urea clearance test repeated on the same subject may give results varying by as much as 50 per cent. Only gross departures from the normal are significant, and proper consideration must be given to other relevant factors. On the whole, the value of the investigation has been overrated in the past.

Electrolytes and acid-base balance

The electrolyte levels of the serum in old age are substantially similar to those prevailing in younger adults and the normal values applicable to young adults can be used.

The acid-base balance of the blood is well described by the Henderson-Hasselbalch equation, which relates the partial pressure of carbon dioxide in equilibrium with the blood (p CO_2), the total carbon dioxide content of the blood and the reaction (pH) of the blood. Shock and Yiengst (1950) found that the pH declined with advancing years (at 38°C the pH was 7·4 for subjects aged 20 to 29 years and 7·368 for subjects aged 80 to 89 years), and the change was statistically significant. They found no statistically significant changes in the pCO_2 and the total carbon dioxide content of the blood, although the Henderson-Hasselbalch equation would require compensatory changes.

Plasma proteins

Olbrich (1948) suggested that the total serum protein level might vary with sex and with age, but Albanese and his colleagues found no difference between young and old (Albanese and his colleagues, 1952). As far as the individual components determined by electrophoresis are concerned, the evidence is conflicting. Albanese and his colleagues found no significant differences. Bock (1948) obtained results in *agreement with Rafsky and his colleagues (1952) who found* a significant fall in the serum albumin concentration (from 60·3 per cent of the total protein at age 19–25 years to 48·6 per cent at age 65–95 years) and a significant rise in the β-globulin (from 12·1 per cent to 16·7 per cent for the same ages). The concentrations of the α- and γ-globulins rose, but the changes were not significant. It is worth noting that much of the lipoprotein moves electrophoretically with the β globulin and the lipoprotein content of serum increases with age.

Lipids

The lipids of serum consist of a number of different substances. Technical methods for the separation and accurate analysis of some of the different fractions are still lacking. The lipoproteins have been studied by ultra centrifugation, and the total cholesterol content can be determined by relatively simple chemical methods.

Glazier and his colleagues (1954) found that four lipoprotein fractions of serum studied with the ultra centrifuge all behaved similarly. In men, the levels rose with age to a maximum at about 50 years, then fell. In women, the levels rose throughout life.

It is well established that the total serum cholesterol is higher in old people than in young (Keys and his colleagues, 1950, Hobson, Jordan and Roseman, 1953)

Becker (1939)

teins in men

TABLE V

THE TOTAL SERUM CHOLESTEROL IN NORMAL MEN AND WOMEN AGED OVER 60 YEARS

	Mean	*80 per cent range*	*98 per cent range*
Men - - -	268	206–348	166–432
Women - -	310	234–410	186–517

The 98 per cent range comprises the middle 98 per cent of values in normals, the 80 per cent range similarly comprises the middle 80 per cent All results in milligrams per 100 millilitres. Based on the findings of Hobson, Jordan and Roseman 1953

In old people over the age of 60 years, values for the total serum cholesterol are set out in Table V. The method used was a modification of that of Bloor. The total serum cholesterol has a lognormal distribution

Alkaline phosphatase

... phatase has a higher mean value in old age than in ... l; Hobson and Jordan, ... lues for the two sexes. The distribution is lognormal

The follo...

age

exp

Mean - - - -	8 3 units
80 per cent range - -	4–17 units
98 per cent range - -	2–31 units

Gastric secretion

It has been real...

age Vanzan

... would not occur with an ... but the two series of results are very comparable

CONCLUSION

In this brief and incomplete survey, little attempt has been made to disc... investigations where no change occurs ...

Two ...

an

numerical result must be considered critically along with the other evidence; it is at least as liable to be wrong.

TABLE VI

INCIDENCE OF ACHLORHYDRIA IN RELATION TO AGE

	Vanzant and his colleagues		Polland	
Age (years)	*No. studied*	*Incidence of achlorhydria (per cent)*	*No studied*	*Incidence of achlorhydria (per cent)*
		Males		
20–39	732	3 0	156	3 2
40–59	918	12 0	172	12 2
60–69	259	23 1	35	31 4
		Females		
20–39	639	7 7	110	6 4
40–59	598	15 5	118	18 6
60–69	196	27 6	32	21 8

Vanzant Alarez Eusterman Dunn and Berkson (1932) gave a meal of arrowroot cookies and water Polland (1933) injected histamine

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CHAPTER 4

PSYCHOLOGICAL ASPECTS OF AGEING

A. T. Welford

SOME THEORETICAL PROBLEMS

when the changes of performance are not for the better, but people incline to it also as a matter of scientific convention, it has been traditional to lay the burden of proof upon those who would transfer responsibility for any behavioural phenomenon from the periphery to central mechanisms of the brain.

We may well question whether the simple peripheral theory is wholly true—clearly it is not—but when we attempt to prove our point we find the task is not at all simple Insofar as the peripheral theory is true we may expect certain relatively straightforward results It is understandable that the maximum attainable visual acuity falls with age, or that the maximum instantaneous strength which can be exerted by a group of muscles becomes less, but there may also be less direct effects For instance failing strength ma

man's performance

of physical effort S

of strength alone, but requires also that other features of the constitution of the organism be taken into account. In consequence, changes of method due to the incipient failure of a peripheral organ may at first sight look like an intellectual defect or a clumsiness in organizing action

Changes in individual links of chain of mechanisms

Equally, however, we have to remember that sensorimotor performance makes use of a whole chain of mechanisms sensory, central and motor, and that failure or partial failure of any one link in the chain will

may seem obvious, but it is easy to jump to wrong conclusions when observing behaviour unless it is kept constantly in mind

Cause of unchanged overall performance

Further problems of

to one or more links

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Yiengst, M J , and Shock, N W (1949) *J Geront.*, **4**, 205

statistical sense There follows the very practical point that performance of older people may be severely limited in particular instances by relatively trivial causes

In any performance the effects of experience and of other capacities more directly dependent upon the state of the physical organism are intimately bound up together For example, if experience is to be applied relevantly to any situation it must be selected and controlled Thus, if a man misinterprets the situation confronting him and brings unsuitable experience to bear it may not be easy for an observer to decide whether this is due to the over potency of some particular past experience, or to a failure of organic origin in the controlling mechanism

A many-sided problem

The upshot of what has been said so far is that in studying ageing we are dealing with a many sided problem We must not expect to be able to point to one single factor as the key to the understanding of all age changes Clearly several changes are acting together and although in any individual case one may be crucial, others may become so if the situation alters even a very little Eventually it may be possible to list a few factors of predominant importance, but the identification of these and the prediction of behaviour by means of their assessment in individual cases lies in the future

The immediate effect of the progress in thought and research which has brought us to this point of view, has been the fragmentation of the field of ageing so that the results of studies made of older people at various tasks appear [illegible]
they would have don [illegible]
prelude to solid resear [illegible]
What we shall do in [illegible]
appear to be developing in current work, trying to indicate not only what is already known, but also some of what remains to be discovered

SLOWING OF SENSORI MOTOR PERFORMANCE

Slowing of sensori motor performance is one of the most obvious and best recognized changes that come in middle and old age The classical work on the subject is that of Miles (1931) who took a series of performance measures from 863 men, women and children, with ages ranging from 6 to 95 and [illegible]
equal n[illegible]
into tw[illegible]
former [illegible] to lift the forefinger of his dominant hand from a key on hearing a buzz One of the latter type of task was turning the crank of a hand-drill mechanism forming a 5 inch circle as fast as possible for 10 seconds The results showed the reaction time measure as almost the same from the twenties to the early sixties and thereafter as lengthening slowly Changes in the speed of crank turning began sooner and were substantially greater

Reaction and times

It is at first sight a reasonable, although incorrect, inference from these results that the locus of slowing with age lies more in the motor than in the sensory

occurs There seem to be at least two possible ways in which this result may come about One is that the mechanisms are in fact not being stretched to their limits We often imagine that the level of our performer depends upon the efficiency of all the mechanisms involved, but clearly this is not so Each mechanism which contributes to the performance must attain a certain minimum level of functioning if it is to play its part, but it need not attain more Thus the performance as a whole will be limited not by the whole chain together but by one link only Sometimes this will be a function which is stretched to its limits by the task being done, but often it will be some standard set by the performance as "reasonable" in terms of his own personal and social background This kind of limitation by one factor is well known in other scientific fields (Blackman, 1905) When it occurs in human performance, many changes of capacity with age, fatigue or other factors will have little or no effect up to a point Beyond this point they will themselves set a limit to performance which will show a functional dependence upon them

The second way in which this kind of result may occur is where the performance is so organized that deficiencies in one respect can be compensated for by improvements in another Indications of such compensation are contained in several experiments (Welford and his colleagues, 1951, Kay, 1955)

While both these ways may result in overall achievement being for a time unchanged, their effects differ in that the first shows no change at all in performance until the point at which achievement begins to fall, while in the second case the manner of performance may change some time before this point is reached, for a time the same achievement may be attained but in a different way This last matter would seem to be of considerable importance in relation to industrial work, as will be discussed later It means that as a man gets older he may not show a fall of performance at his job, but it may become more and more of a strain until eventually he breaks down or finds opportunity to change to a job making less severe demands

Detailed analysis necessary

Sorting out the relative parts played by central and peripheral mechanisms in bringing about age changes demands, therefore, more painstaking analysis than would at first sight appear necessary The same is true if we try to distinguish between the roles of, on the one hand, maturation and degeneration of the physical organism, and on the other, the effects of experience Clearly if the organism is viewed as a piece of physiological machinery it degenerates from the early twenties onwards As against this, experience goes on accumulating throughout life, and we might expect a man's ability at any particular age to depend upon the balance between these two types of factor Again, however, such a view is unduly simple Any particular task which taxes a man will do so by making a high demand either upon some particular department of experience, or upon some function more directly dependent upon the physical organism Thus performance at any one particular task will again be limited by some one capacity and the exact level of others will be irrelevant provided they attain a certain minimum value The capacity which is limiting and the minimum values for others will, of course, differ from one task to another, so that generalizations about the effects of experience or of the state of the physical organism on human capacity are true only in a broad

TABLE VII

TIMES TO INITIATE A RESPONSE AND TIMES TO MOVE. DATA FROM TWO CONDITIONS HAVE BEEN COMBINED. MEAN PER MOVEMENT IN SECONDS

	Age range			
	Twenties	*Thirties*	*Forties*	*Fifties*
Time from appearance of signal to beginning of responding movement – – – – – –	0 86	0 99	1 29	1 37
Duration of responding movement – – – – – – –	1 18	1 20	1 14	1 22

does not apply Two groups of subjects with average ages of 27·6 and 26 9 years were compared with two further groups having average ages of 69 5 and 66·6. The subject sat facing a display of five light bulbs at the corners of a regular

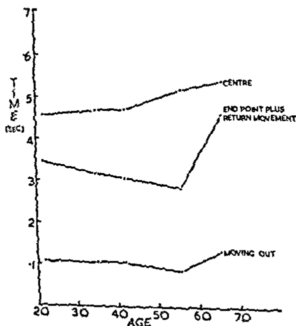


FIG 24 —Component times in a four-choice serial reaction task Means time in seconds per response (*By courtesy of Singleton and Messrs Livingstone*)

pentagon On the table in front of ...
to each light bulb anc ...
a time in random orc ... required to move a stylus from the
centre disc to the disc corresponding to the light which was on, and then back
again as quickly as possible One of the ...

or central mechanisms Miles himself suggested that this motor slowing might be due not so much to a "defect in the mechanism but to a positive check on it—a neural governor device protective of the mechanism" He suggests that "the weight of years may be in large part *neural inhibition-interference to action*" (Miles, 1931) If this is true we should expect that in certain circumstances it would be possible to overcome this inhibition and obtain motility measures as high for older as for younger subjects Evidence from studies other than those of Miles confirm this, at least up to a point They also indicate, however, that the lack of change with age in Miles' reaction time measure was a special case, and that in fact, it is in processes lying between the onset of a signal and the beginning of the responding action, that is in the *reaction time*, that the main locus of slowing is to be found

Several investigators report greater changes of simple reaction time than those found by Miles (Ruger and Stoessiger, 1927, Bellis, 1933) As Norris and his colleagues (1953) point out, although speed of nerve conduction falls with age, this can account for only about 4 per cent of the change of reaction time from the thirties to eighties It seems clear that the slowing must be in the sensory functions or in the central processes which effect the transition from sense data and guide movement

Movement time

General theoretical considerations regarding continuous action make it likely that the central processes concerned with the control and "monitoring" of movement do normally limit the speed of action (Welford, 1952, Crossman, 1953 Fitts, 1954) The increasing importance of this with age is suggested by the work of Birren and his colleagues (1954) who found a correlation which rose with age between writing speed and the obviously central task of adding Some early experiments by the group to which the writer belongs provided observational evidence in the same direction, but the first clear indication was in an experiment by Szafran (1951) The subjects sat in a kind of cockpit surrounded by targets, when a light signal was given on a display panel facing them they had to move a stylus from a point directly in front of them to the centre of the target indicated The task had to be done first with full opportunity to see the targets, then with goggles which left the lights visible but which completely obscured everything else. The results of the experiment as a whole do not concern us here, but we may note that the time taken between a display light coming on and the subject beginning to move the stylus increased significantly from the twenties to the fifties in both conditions The actual time spent moving to the target showed a non significant increase on one condition and in the other a slight decrease The results are shown in Table VII We cannot be certain in this experiment whether these results are due to the older subject being unable to initiate his movements more quickly, or whether there is some tendency for older people to make sure where they are going to move before they start whilst younger people tend to start a movement quickly and then modify it as it proceeds, but both possibilities are clearly raised

The evidence from this experiment may be questioned because the instructions did not specifically mention speed and the subjects may, therefore, not have been working as fast as possible Further indications of the same kind are, however, given in a serial reaction experiment by Leonard (1952) in which this objection

C via J The times spent at the various turning points and in moving between them are shown in Fig 26 The movement times again fall as far as the forties, thereafter rising a little The stationary times at the points where direction is changed are on average level until the forties and then rise, moderately to the fifties and sharply to the sixties

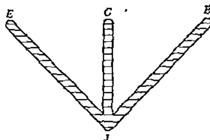


FIG 25 —The shaded area represents the possible paths of movement in Singleton's two-choice task (*By courtesy of Singleton and British Journal of Psychology*)

The movements in the previous two experiments were all of small extent, that is

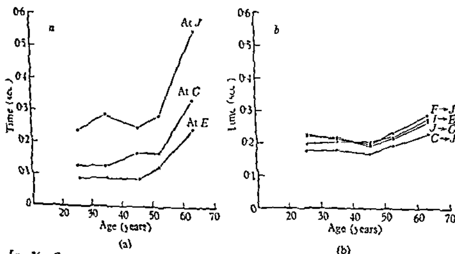


FIG 26 —Component times in a two-choice serial reaction task Mean times in seconds per response (a) stationary times, (b) movement times (*By courtesy of Singleton and British Journal of Psychology*)

lever working in a slot from side to side as rapidly as possible between end stops about 18 inches apart Measures were taken which enabled the times for the first and last quarters of the movement to be taken separately from that for the ...
The times for the vario...
shown in Fi...
no rise wit...

to the centre disc The pattern of results under both conditions was clear The older subjects took substantially longer than the younger, but practically the whole of the extra time was spent on the discs, where choices of where to move next would normally be made The times spent actually moving were closely similar for both younger and older groups The results are given in Table VIII

TABLE VIII

MOVEMENT TIMES AND TIMES AT POINTS WHERE DIRECTION IS CHANGED MEAN PER MOVEMENT IN SECONDS

	Time on discs	*Time moving between discs*
Light changing when indicated disc touched		
Younger group	0 38	0 31
Older group	0 79	0 31
Light changing when centre disc touched		
Younger group	0 59	0 27
Older group	0 92	0 32

Separate measurement of reaction time and movement time

In order to confirm this result and to achieve a clear separation between reaction time and movement time further experiments were carried out by Singleton (1954, 1955) The subject in the first of these sat facing a display of four light bulbs and with a vertical lever between his knees The lever was made to move in slots forward, back, left or right, each direction being indicated by one of the lights on the display The task was that when one of the lights came on the subject had to move the lever as fast as possible to the end of the appropriate slot and back again If he moved in the correct direction the light went out as soon as he reached the end of the slot and the next light came on as soon as he returned to the centre The task was thus a serial one, each correct response bringing on the next signal Each run continued until 64 correct responses had been completed

This arrangement made it possible to measure reaction time (that is, time spent at the centre) and movement time (that is, time to move out and back along the slots) separately and very precisely The results of doing this are shown in Fig 24 The centre times show a small but significant increase with age The movement times show a slight *fall* to the fifties but an increase to the sixties It seems clear, however, that this latter increase is due to the subjects in their sixties tending to pause at the end of the slot before returning the actual movement as indicated by the "moving out" times shown on Fig 24 differs very little, and not significantly, with age

Singleton obtained the same pattern of results using a different group of subjects with a task where the lever could be moved in either of two directions but with a more complex movement The pattern of movement is shown diagrammatically in Fig 25, from C *via* J to either E1 or E2 as indicated in the display, then back to

C via J The times spent at the various turning points and in moving between them are shown in Fig 26 The movement times again fall as far as the forties, thereafter rising a little The stationary times at the points where direction is changed are on average level until the forties and then rise, moderately to the fifties and sharply to the sixties

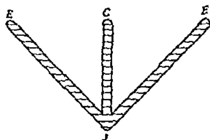


Fig 25 —The shaded area represents the possible paths of movement in Singleton s two-choice task (*By courtesy of Singleton and British Journal of Psychology*)

The movements in the previous two experiments were all of small extent that is

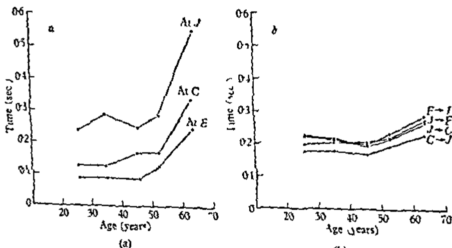


Fig 26 —
respor
Journc

lever working in a slot from side to side as rapidly as possible between end stops about 18 inches apart Measures were taken which enabled the times for the first and last quarters of the movement to be taken separately from that for the middle The times for the various portions of the movement and for the
shown in Fig 27 Rather
no rise with age, inc

carried out as fast by the older subjects as by the younger The *middle portion* does show some slowing suggesting that with movements of larger extent than those in Singleton s former experiments some slowing of movement itself may contribute to the longer time taken by older subjects Once again we see from *Fig 27* a sharp rise in the time spent by the sixties at the end point where the direction of movement is changed Why there should be this consistent tendency for the oldest subjects to take a long time changing direction is not clear Part of the reason may lie in the fact that their actions appear jerky in other words they are using the end stops to arrest their movements This is not a complete explanation however because the same delay when changing direction was evident

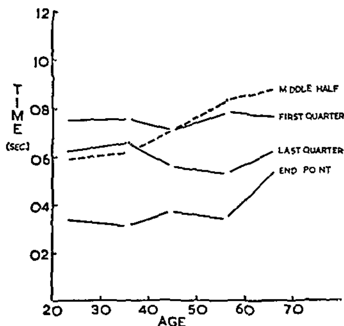


FIG 27—Component times of a simple movement Mean times per movement (*By courtesy of Singleton and Messrs Livingstone*)

in Leonard s experiment where there were no end stops and the movement was free Further research would seem to be needed

These experiments do not indicate conclusively whether the increase in stationary time (such as centre time in Singleton s four choice experiment) is due to older subjects taking longer to initiate choice reactions or to some after effect of movement being of longer duration in older people The latter possibility is rendered unlikely however by the results of further experiments by Szafran which will be described later It seems reasonably clear that in continuous sensori motor tasks involving short light movements limits of speed for older people are set more by slowing of sensory processes or central control than in the actual execution of the *movements* themselves

The apparent discrepancy between these results and those of Miles would seem to lie in two facts First that when reaction times are measured in the way Miles took them much of the work of reacting can be done in anticipation of the actual signal *and is thus not measured in the reaction time* This is not so in serial reaction tasks which thus give a more accurate picture of the time taken by

the process as a whole. The second fact relates to Miles' "motility" measures.

task but involves also a great deal of central co-ordination and control.

Choice reaction

cate that at least part of the of making choice reactions ve recently studied relationships between degree of choice and reaction time Their work shows reaction time to be proportional to the logarithm of the number of equi-probable choices (or their equivalent) of action before the subject, or in other words that the rate of gain of "information" (in the information theory sense of the word) is a constant, at least for any one class of material Experiments by Fitts (1954) have shown that Hick's (1952) law approximately holds for simple hand and arm movements over distances of 2–16 inches The time taken by back and forth movements between two targets was proportional to the logarithm of the ratio between twice the length of the movement and the width of the targets It seems on the experimental evidence at least plausible to suggest that many age changes of performance were due to this rate of gain becoming lower with age. If so, we should expect that in choice reaction and sorting tasks the time taken by older subjects would be greater by a *constant proportion* than that taken by younger subjects

Movement times between targets

Welford obtained times for moving back and forth between two targets either 1 inch or 2 inches in diameter and either 1 foot or 2 feet apart. Table IX shows that there is a proportionate increase of time taken between the twenties and forties which is the same for different target sizes at either one distance. The increase is, however, not proportionate between these ages for different distances, and departs widely from proportionality between the twenties and thirties

TABLE IX

MOVEMENT TIMES BETWEEN TARGETS. WELFORD'S DATA MEAN PER MOVEMENT IN SECONDS

	1' *movements*		2' *movements*	
	2" *targets*	1" *targets*	2" *targets*	1" *targets*
Twenties	0 237	0 289	0 338	0 398
Thirties	0 289	0 354	0 373	0 455
Forties	0 352	0 431	0 472	0 55
Proportional increases				
Twenties/Thirties	0 22	0 22	0 1	0 14
Twenties/Forties	0 49	0 49	0 4	0 39

Card-sorting experiment

Clearer evidence against proportionality is contained in a card-sorting experiment by Szafran. The cards had to be sorted into two or more categories as shown in Table X. The condition of "no-choice" was obtained by pre-arranging the pack with two categories alternately so that the subject knew what was coming and did not have any real choices to make while he was sorting. This "no-choice" category provides a measure of the time taken to perform the actual sorting *movements* uncomplicated by having to make choices.

TABLE X

TIMES TO SORT CARDS INTO DIFFERENT NUMBERS OF CATEGORIES: SZAFRAN'S DATA. MEAN PER CARD IN SECONDS

	Degree of choice			
	0	2	4	8
Age ranges				
Twenties and thirties	0.49	0.85	1.1	1.45
Forties and fifties -	0.51	0.95	1.15	1.5
Sixties and seventies -	0.59	1.2	1.45	1.75
Differences				
b–a - - - - - - -	0.02	0.1	0.05	0.05
c–a - - - - - - -	0.1	0.35	0.35	0.3

As is not unexpected from Leonard's and Singleton's experiments, the time taken for the "no-choice" category differs little with age. The age difference for two choices is very much greater. Age differences for higher degrees of choice are not, however, greater in proportion, but surprisingly, of about the same *absolute* magnitude as those for two choices.

Szafran's results do, in fact, agree with those of Birren and Botwinick (1951) and Birren and his colleagues (1952) who found that the largest proportionate age difference of time taken at adding tasks occurred with the shortest tasks, being greatest for adding two digits and becoming steadily less as the number of digits was increased. Care was taken to remove the possible influence of writing speed upon this result.

It is premature to draw any definite conclusions from these experiments, but they suggest that slowness with age may in some cases be due to a factor which is associated with either decision or choice, or the initiation of action and is the same whatever its complexity. What is done during the extra time we do not know, but one possibility is that it represents a shift from cognitive activity to the taking of action. In other words, it may represent one aspect of a general tendency to require extra time as one gets older to adjust one's "set" or to shift from one action to another *however small the change involved may be*. The slowness shown by Singleton's oldest subjects in changing direction of movement may be another aspect of this tendency.

From the practical standpoint these results, if not due to some artefact or error of sampling, have the surprising implication that older people may be least

slow, as compared with younger, at tasks involving somewhat elaborate choices. Everyday experience does, perhaps, furnish evidence which lends some support to this view.

Effects of advance information and pacing

We might expect, following the results of these experiments, that older people would benefit more than younger from being able to see signals ahead of the time at which they have to react to them, so that they have plenty of time to observe them and form their responding actions

Some evidence that this is so is provided by an experiment in which the subjects were required to "drive" a ballpoint pen along a track by means of a steering wheel The wheel moved the pen on a carriage to and fro across a strip of recording paper which carried an irregular wavy track. The paper was set perpendicular to the subject's line of sight and was pulled downwards past a window in which the point of contact of the tracking pen could be seen. A shutter could be

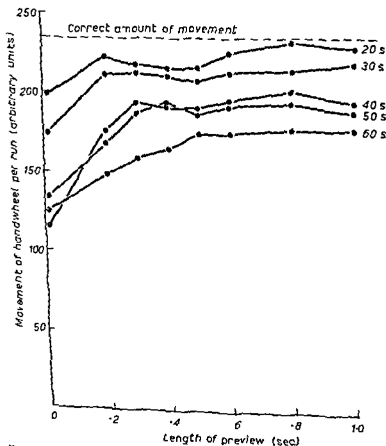


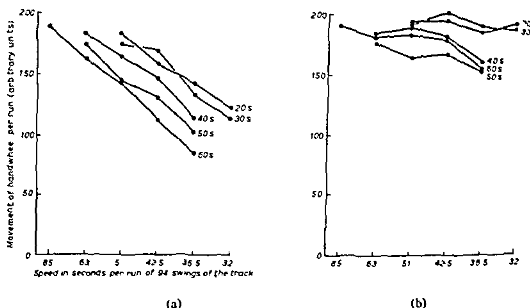
FIG 28 —Relations between length of preview and performance at a tracking task

raised or lowered to reveal more or less of the track before it reached the point where it passed the pen When the track is moving fast, as it was in this experiment, the amount of movement of the subject's wheel seems to be a sensitive indicator of how well he is tracking, a breakdown being shown by a reduction in the amount of movement, due not to omission of some of the required "swings", but to their being smaller than they ought to be Scores showing the relation of amount of movement to amount of preview are shown in Fig 28 It will be seen that with increasing preview the scores for each age group rise to something near a maximum and then remain flat except for minor variations The point at which this rise ceases and the near-maximum is reached varies with age from a 0 2 second preview among the twenties to 0 5 second preview in the sixties

Pacing

The maximum performance shown in Fig 28 falls markedly with age All the subjects in this experiment did also two runs, one with no preview and one with preview for 3 seconds, at rather less than half the speed The scores at this lower speed showed very much less change with age

Such a result is understandable, because a tracking task like this is "paced" in the same sense as a conveyor belt may pace factory work Each turn of the track



(a) (b)

FIG 29—Relations between speed preview and performance at a tracking task (a) without preview (b) with preview of at least 1 second

has to be reacted to as it comes, and if it is not dealt with in time the opportunity for doing so does not recur If the pace is raised it will eventually cause breakdown of even the quickest performance, and if people become slower for any reason at all as they get older, the breakdown point will come at a lower speed To view the matter another way, a fixed time allowance which is "tight" will have more effect on older than on younger people

Reaction times and movement times vary from moment to moment so that if we plot the times for individual cycles of a repetitive task we obtain a distribution with a "hump" around the average performance time and with "tails" of quicker and slower cycle times If each cycle has to be performed within a rigidly prescribed time, part of the long tail is likely to lead to errors. As the speed of the task is raised and the cycle time is shortened more and more of the tail will fall outside the prescribed limit, unless the subject can in some way "draw in" the *long time* This he might be able to do by making his performance more hasty or perfunctory, a course likely to impair accuracy.

[illegible]

ments of the steering wheel still have to be executed at strictly determined times, the preview gives some latitude to the perceptual and central processes, so that if they are slow at one moment they have a chance of making up time later.

Paced work in industry —There is some evidence that tasks in factories paced in this way are unfavourable to older people especially when the pacing is combined [illegible] nportant to note [illegible] o show as a fall [illegible] women to seek [illegible]

TABLE XI

Operations involving	Moves with age	No moves with age
Both pacing and continuous bodily movement and activity	10	1
Pacing without continuous bodily movement and activity	3	3
Continuous bodily movement and activity without pacing	6	7
Neither continuous bodily movement and activity nor pacing	0	77

Similar evidence is given in a study by Richardson (1953) of older men on very heavy work He found an increasing proportion of men moving to light work as they became older, especially after the age of 50 years Richardson states that "the most important component of light or lighter work, as these terms were used by the men interviewed, was (the) opportunity to control the pace of work and the distribution of rest pauses".

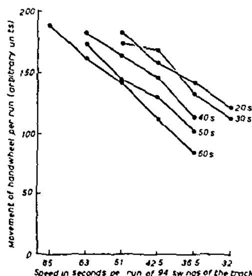
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raised or lowered to reveal more or less of the track before it reached the point where it passed the pen When the track is moving fast, as it was in this experiment, the amount of movement of the subject's wheel seems to be a sensitive indicator of how well he is tracking, a breakdown being shown by a reduction in the amount of movement, due not to omission of some of the required "swings", but to their being smaller than they ought to be Scores showing the relation of amount of movement to amount of preview are shown in Fig 28 It will be seen that with increasing preview the scores for each age group rise to something near a maximum and then remain flat except for minor variations The point at which this rise ceases and the near-maximum is reached varies with age from a 0 2 second preview among the twenties to 0 5 second preview in the sixties

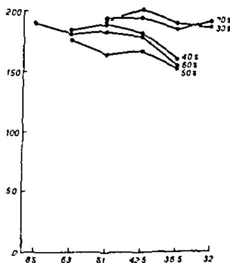
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(a)



(b)

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entirely a matter of the resolving power of the eye we might expect to find a threshold above which discrimination was possible and below which it was not. Weston's experiment is not entirely straightforward to interpret because both time and error scores were affected by the variables he studied and we cannot be sure how much time should be regarded as equivalent to any given number of errors. Insofar as slowness did occur, however, and did increase with age we may well ask what was its nature and how the extra time was spent. No certain answer can be given to this question as it is one which studies of vision have largely avoided facing. We may, however, in relation to age note two facts. Firstly, there is the well-confirmed finding that the critical flicker frequency—that is the speed at which "on" and "off" in a continuous series can be discriminated—falls with age (*see* Brozek

fairly fast random activity.

A theory of brightness difference discrimination

incoming signal and other, including random, activity in the visual pathways and brain. Gregory (1955) has suggested, and has related his suggestion to ageing phenomena in perception, that in order to distinguish between an incoming signal and the moment to moment activities in neuronal activity carrying the signal the subject has as it were to take a *statistical* "sample" of the signal activity. The sample size

which the

tion would

variations

visual disc ... a small fraction of a second, but could make a substantial proportional difference to the time taken over a visually exacting task. As an explanation of age changes the theory is attractive because it is consistent both with the electroencephalograph evidence and also with the observation that active brain cells become fewer with age (*see* O'Leary, 1952).

A number of suggestions *follow from*

... in relation to age we need to make sure the tasks presented to the subject are not such as to require fine detail discrimination. Secondly, from the practical

brain might

we should

The performance of older people at paced work in industry is a matter that would repay a great deal of further study In particular, it would be valuable to discover how far older employees could be helped by "buffering" so that they would be able to compensate for momentary slowness We want also to be able to answer the fundamental question of how far a man's performance under paced conditions can be predicted from his performance unpaced Is it simply that the tail of his distribution of responses is cut off? Or do other factors enter to change the nature of performance, and do these other factors change with age?

PERCEPTION

An important experiment by Weston (1949) indicates that loss of visual acuity with age may be more severe than is revealed by the tests commonly used by ophthalmologists

He gave a group of subjects, with ages ranging from about 20 to 45 years, sheets of Landolt rings with instructions to cancel with a pencil each one having the break in a certain direction The rings were of three different sizes, having gaps subtending 4 5, 3 and 1 5 minutes, and of four different contrasts, 0 97, 0 56, 0 39 and 0 28, all on different sheets They were presented at six different illuminations ranging from 0 5 lm/ft² to 512 lm/ft² Measures taken were the number of rings correctly cancelled in a given time and the number of errors made, usually omissions Allowance was made for the time taken by the motor part of the task as opposed to the visual discrimination part by deducting the time taken to deal with sheets of rings where those to be cancelled were clearly marked in red thus requiring no fine visual discrimination

The twelve subjects were all able to read the Jaeger 1 test type for near vision, correcting glasses being worn if necessary, and were closely similar for far vision on Snellen charts There was thus equality between the ages and adequacy at all ages on these tests of visual acuity Nevertheless, performances at cancelling the Landolt rings showed a definite fall with age even for the largest rings with the best contrast at the highest illuminations Smaller size of ring, poorer contrast or lower illumination each singly made some difference to performance which increased with age In combination, their effects increased sharply from small differences among the youngest subjects to profound declines among the oldest

Weston points out that from these results it would appear that although high levels of illumination can bring closer together the performances of younger and older people on fine visual tasks there would seem to be no level of illumination at which they could be made equal He discusses his results in the light of previous work on visual acuity, and notes that the declines shown by his subjects on a timed task are much greater than on the untimed tasks used previously Since the times he used *already made allowance for the actual actions of cancelling,* the lengthening with age of time taken must imply a slowing somewhere within the processes concerned with vision and perception

Speed and visual acuity

The question of speed which this experiment brings into the field of visual acuity measurement raises difficult theoretical issues If loss of visual acuity were

entirely a matter of the resolving power of the eye we might expect to find a threshold above which discrimination was possible and below which it was not Weston's experiment is not entirely straightforward to interpret because both time and error scores were affected by the variables he studied and we cannot be sure how much time should be regarded as equivalent to any given number of errors Insofar as slowness did occur, however, and did increase with age we may well ask what was [illegible]

finding that the critical flicker frequency—that is the speed at which "on" and "off" in a continuous series can be discriminated—falls with age (*see* Brozek [illegible]

fairly fast random activity

A theory of brightness difference discrimination

[illegible]

and [illegible]

phen[illegible]

and t[illegible] activities in neuronal activity carrying the signal the subject has as it were to take a statistical "sample" of the signal activity The sample size is limited by both the area stimulated by the signal and the time over which the sample is taken so that the period of time required to make a discrimination would up to a point, increase for any given fineness of detail as the random variations become larger relatively to the signal The increase [illegible]

[illegible] theory is attractive because it is consistent both with the electroencephalograph evidence and also with the observation that active brain cells become fewer with age (*see* O Leary, 1952)

A number of suggestions follow from this theory which deserve careful consideration First, slowness at fine visual tasks could on the face of it, be due either to the peripheral organs supplying weaker signals for a given level of stimulus, or to increased randomness in the visual pathways and brain, or to both Therefore to study the central aspects of perception in relation to age we need to make sure the tasks presented to the subject are not such as to require fine detail discrimination Secondly, from the practical stand[illegible]

[illegible]

[illegible] deafness Fourthly, we should

expect that in compensation for deficiencies of this kind older people would tend to seek stronger "signals" from their environment, by taking steps either to raise the level of data from the senses they are primarily using, or to supplement data from one sense by that from others Szafran (*see* Welford and his colleagues, 1951) observed this tendency in subjects over the age of about 30 years in that they looked at what they were doing more frequently than did younger subjects He has followed this up in further work, especially the experiment mentioned in the previous section (Szafran, 1951) where the subject was required to aim at the centres of targets either with full vision or while wearing goggles which hid them from view Older subjects found the task with the goggles impossible unless they had previous experience of it without goggles, and even then they tended to turn their whole body as if in an attempt to locate the target more accurately with the help of kinaesthetic data The precise interpretation of this work is, however, not easy and that placed upon it here may well be unduly simple A fuller summary and discussion of it is given by Szafran (1955)

More complex perception

Weston's experiment was concerned with perception in a task where the material was simple and the limitations lay in the strictly visual demands We turn now to experiments which have attempted to study more complex material and to lay more stress on perceptual demands

Identifying incomplete pictures

Verville and Cameron (1946) presented subjects with incomplete pictures consisting of disconnected patches which, when viewed as a whole and with the gaps filled in by the subject's imagination, could be seen as objects Each picture was projected onto a screen and shown until it was named correctly, when it was switched off They found clearly marked differences between a group of college students from 16 to 23 years of age and a group of adults from 35 to 56 years of age, in the time taken to identify pictures correctly Part of the difficulty of the older subjects seemed to be that each picture tended to produce a "set" towards the next Thus, "some subjects after correctly identifying the first picture as a frog, continued to name animals for one or more succeeding pictures" Verville and Cameron note there were considerable age differences in the ease with which particular pictures could be identified

They also point out that there was a difference of attitude to the experiment between older and younger subjects, the former tending to be more apprehensive about their ability, especially if they considered the experiment to be a test of intelligence This is a frequent finding (Welford and his colleagues, 1951), and is relevant to the objection sometimes raised to psychological studies of older people that they are not willing to try their best at the tasks given them The evidence seems almost always to be that the reverse is true, it may be difficult to persuade older people to subject themselves to an experiment at all, but if they do they almost always try their best If unequal motivation between younger and older may affect results, it is over-motivation and not under-motivation among the older subjects that usually needs to be considered

Integration of information

All perception involves some integration of information over a period of time, ... temporal character whilst in vision the

f ... ...

visible at any one time Two groups ... sixties and seventies were shown displays of four types (1) simple geometrical figures such as a square, (2) more complex block figures such as a star or cross, (3) representional silhouettes, and (4) pictorial line drawings Each was shown with the narrowest slit (0 1 inch), and if it was not identified it was shown again with a slit 0 2 inch wide and so on up to 0 5 inch when if it was still unidentified it was not tried again The pictures moved at 1 inch per second and were about 3 inches high

The results of this experiment are shown in Fig 30 Older and younger subjects were similar in their achievements with the simplest designs (a) and the silhouettes (c) showed a little more difference with the silhouettes (b) and very marked differences with the line drawings (d)

The experiment was repeated using line drawings only, with two groups of ... to determine the point at which the ... ties gave fairly similar ... and another decline to the sixties The two groups differed in educational and occupational status and it ... in the group which was higher in these respects ... the lower ... uch larger ... of tests by

Pacaud (1955) She found clear differences with education in tests of intellectual, memory and learning functions but in each case the difference between educationa levels either was the same among both younger and older, or a large differenc among younger subjects was reduced among older Pacaud found that difference between educational levels at sensori motor tasks was small in all the age range she studied

The same influence of 'set' noted by Verville and Cameron could be see among Wallace s subjects, who in addition showed a tendency to repeat for an one display previous incorrect identifications even though they had been tol these were wrong The results are in this respect closely in line with those of Ka (1951) using a learning task in which older subjects showed a striking tendency t repeat errors which they had been shown to be wrong The tendency in Wallace experiments was, however, not quite consistently related to age, and the extent t which the repetition of errors is to be regarded as a phenomenon of ageing nee further consideration

A series of control experiments by Wallace indicated that difficulty of integrati the material presented serially in time may have been part of the cause of the low performance of the older subjects, but could not be the sole explanation If

had been, the difference between younger and older should have disappeared when the pictures were shown, each in its entirety, in a tachistoscope. Under these conditions marked age differences remained. It appeared that both total time for which a picture was seen and amount seen at once were important, and that if the pictures were seen whole for a sufficient time the oldest subjects could identify them all correctly.

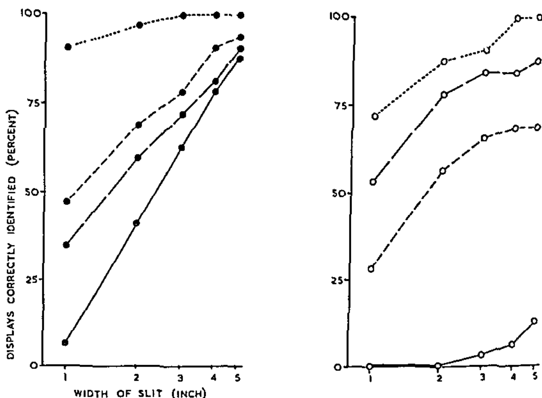


FIG 30—Perception of different types of material Wallace's data Cumulative percentages of displays correctly identified after successive exposures are plotted

Filled circles	subjects in twenties
Open circles	subjects in sixties and seventies
Dotted lines	simple geometrical figures (a)
Short dashed lines	block figures (b)
Long-dashed lines	representational silhouettes (c)
Continuous lines	pictorial line drawings (d)

Wallace's results are consistent with, although they do not definitely prove, the theory that older people take longer to extract data from a display On this theory the importance of viewing time is obvious. The importance of seeing the display whole lies in the fact that the better "articulation" of the display when it can be viewed all together enables certain details to be neglected and thus reduces the amount of information required to identify it correctly.

The fact that these displays could all be identified without difficulty when seen whole for a sufficient length of time means that the lower performance of the older subjects was not due to poorer visual acuity as measured by the usual tests It could however have been, at least partly, a manifestation of the same deficiency

as that shown by Weston's experiment The age differences in Wallace's cases seem, however, to be rather large to be accounted for entirely in this way

As regards more strictly perceptual factors, slowness of recognition could be due to difficulty in selecting from among categories of identification which lie within the subject's repertoire Without further evidence it is not possible to say whether this difficulty (if it occurs) lies in some failure of the subject's " selection mechanism" or whether it is due to the effects of increased experience A wider range of experience would mean more possible categories of identification and therefore a greater task to arrive at any particular one (Hick, 1952) Alternatively, an experience in which some items were more frequent than others would be likely to make slower the identification of all items other than these (Crossman, 1953, Hyman, 1953)

TABLE XII

NUMBERS OF WORDS WRITTEN IN 2 MINUTES EXAMPLE FROM BIRREN (1955)

	Age range							
	16–19	20–29	30–39	40–49	50–59	60–69	70 79	80–89
Words beginning with C	20 7	22 0	25 2	20 0	16 0	8 4	5 6	5 6
Writing speed	45 2	48 0	47 1	38 0	29 4	22 0	16 5	15 2

The likelihood that central perceptual factors as opposed to purely visual change were pl...

re

qu ... ords beginning with a stated le...

... An example of the results are given in Table XII Birren's task was in a sense the complem...

... studied by Bartlett (1932)

RELATIONS BETWEEN DISPLAY AND CONTROL

One of the most striking developments of applied experimental psychology during and after World War II was the ...
ships between the form of displays
actions required With direct ha...
relationship between what is seen
or ...

exists between particular signals and actions With many machine tools and other devices this is not so, and the direction, form and force of actions may bear only indirect or symbolic relations to the signals in the display and to the effects the actions produce In this latter case it would appear that some intervening step involving choice or judgement has been inserted between the perception of the display and the taking of action There seems to be good evidence that at least some types of situation where such intervening steps have to be taken are relatively more difficult for older than they are for younger people

One example of this indirect relationship is given by tasks such as that of Ruch (*1934*) who compared performances on a pursuit rotor when seen directly and *via* a mirror Subjects were required to keep a stylus within a small area on a revolving turntable The performance of subjects fell off between the teens and seventies much more with the mirror than on the straightforward task Similar results were obtained by Szafran for throwing at a target seen only in a mirror accuracy of throwing fell from the teens, twenties and thirties to the forties and again to the fifties (Welford and his colleagues, 1951)

The step required in mirror tasks is a spatial transposition which has to be made mentally in order to relate display to action, and results similar to those obtained with a mirror have been found by Szafran (1955) in other conditions where spatial transpositions have to be made For one of these the subject sat at a table having two levels On the upper level were several numbered discs at varying distances from one disc designated as the starting position This latter was indicated by a projection which the subject could feel on the lower level immediately below the disc on the upper The task was to move the hand from the starting position to positions judged to be directly below the various numbered discs The subject's hand and arm were hidden from view so that the movements had to be made without the guidance of vision Subjects of varying ages from the twenties to the sixties showed no differences in their accuracy of carrying out this task When, however, the same horizontal arm movements were required to the same display placed vertically, performance fell with age The need to make a transposition between the display and the arm movement seemed to have introduced a difficulty which increased as the subjects became older The difficulty in these cases may reasonably be linked with deficiencies in the older subjects' spatial frame of reference such as was suggested by Szafran's experiment on aiming with a stylus (1951)

Effects of intervening steps involving both simple spatial and symbolic transformations are shown in experiments by Kay (1954, 1955) Subjects were confronted with a box containing a row of twelve small light bulbs, and another box containing a corresponding row of twelve morse keys One of the lights was on, and by pressing one of the keys the subject could put it out whereupon another would come on, and could be put out by pressing a different key and so on

For one experiment (Kay, 1955) the keys and lights were connected so that the correct key was always the one immediately below the light which was on The task was to make 30 correct moves at whatever tempo the subject desired It was given under three conditions (1) with the lights directly above the keys (2) with the lights 3 feet behind the keys, and (3) the box containing the light bulbs was *turned end to end*, still at 3 feet distance

The times taken and errors made by the various age groups at this task are shown in Table XIII In the (a) condition there was a small but fairly consistent rise with age in time taken Condition (b) shows a substantial rise of time in the two oldest age groups coupled with a fall in the number of errors The greater difficulty presented by condition (c) is shown by the fact that both times and errors increased for all age groups and the rise of time taken by the oldest groups occurred with no corresponding fall in errors

TABLE XIII

TIMES AND ERRORS AT A SPATIAL TRANSPOSITION TASK DATA FROM KAY (1955)
MEANS PER SUBJECT PER RUN OF 30 RESPONSES

Age range	*Condition* a	b	c
		Times in seconds	
15–24	22 8	38 4	75 9
25–34	23 9	37 7	86 5
35–44	23 4	38 6	76 6
45–54	24 3	37 6	85 9
55–64	25 5	44 8	92 9
65–72	26 9	47 5	126 7
		Errors	
15–24	0	5 5	9 1
25–34	0	4 2	10 1
35–44	0	3 9	8 3
45 54	0	4 5	10 6
55–64	0	3 5	7 8
65–72	0	2 4	8 2

It seemed clear that the younger subjects were, especially in condition (b), sacrificing accuracy for speed, whilst the older subjects were tending to do the opposite This tend[illegible]
noted in o[illegible]
fairly com[illegible]
which are[illegible]
concentrat[illegible] on accuracy is compulsive and how far it can be abandoned at will [illegible] for older people to is not known It would seem clearly to be another facet of the care and caution suggested by the results of other experiments alread[illegible]

[illegible] pertinent by
transformation
three further conditions with the addition of an index card carrying the numbers [illegible] the same apparatus was used under

1–12 (one for each key/light pair) in random order The subjects were given the following instructions

(1) Think of the lights as being numbered 1 to 12 from the left
(2) When a light comes on decide which number it is
(3) Find that number on the card
(4) The correct key to hit is the key in line with the number on the card

The different conditions concerned the position of the index card In condition (i) it was immediately above the keys, in condition (ii) half way between the keys and the lights, and in condition (iii) immediately under the lights The layout of apparatus for conditions (i) and (iii) is shown in Fig 31

TABLE XIV

TIMES AND ERRORS AT A TASK INVOLVING BOTH SPATIAL TRANSPOSITION AND SYMBOLIC TRANSFORMATION DATA FROM KAY (1954) MEANS PER SUBJECT PER RUN OF 20 RESPONSES

Age range	*Condition (i)*	*Condition (ii)*	*Condition (iii)*
		Times in seconds	
15–24	56 4	70 8	84 8
25 34	54 2	71 7	111 6
35–44	62 0	85 7	137 1
45–54	64 1	96 3	174 7
55–64	73 7	124 8	229 3
65–72	84 7	198 7	445 3
		Total errors	
15–24	1 2	2 9	4 0
25–34	1 3	3 2	8 5
35–44	2 6	4 5	13 6
45–54	2 6	8 5	23 5
55–64	3 6	7 3	33 6
65–72	3 1	15 0	47 9
		Errors of a type reducing condition (iii) to condition (i)	
15–24	0 6	0 2	1 0
25–34	0 8	0 7	1 8
35–44	0 5	0 8	4 4
45–54	0 3	1 7	7 6
55–64	0 2	1 7	11 6
65–72	0 4	5 0	15 6
		Errors of a type reducing task to that of condition (b) of preceding experiment	
15–24	0	0 4	1 3
25–34	0 3	0 7	2 9
35–44	0 5	0 7	5 0
45 54	0 4	2 2	8 5
55–64	0 4	2 1	11 4
65–72	0 5	5 2	22 6

The instructions applied equally to all three conditions, yet, surprisingly, these differed greatly in difficulty The times taken and total errors made for each condition by the different age ranges are set out in Table XIV The symbolic

transformation involved in numbering the lights and finding the number on the card clearly added, in all age groups, to the difficulty of the task compared with that in the previous experiment The changes with age were greater and more consistent, and both times and errors rose proportionately more with age as the difficulty increased

The reason for condition (iii) being more difficult than (i) would appear to lie in the fact that (i) does not require the subject to align across a gap The gap in (i) between the lights and the keys is crossed by the use of the number taken from the lights and found on the index card With condition (iii) the subject has not only to find the number on the card but having done so to align across the gap to the

either of these intermediate steps taken separately, but very great indeed when both were required together Adding one difficulty to another appears to produce a degree of change with age in performance far greater than would have been predicted from the study of either difficulty on its own

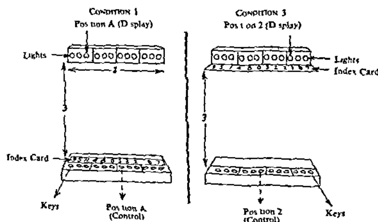


FIG 31 —Layout of apparatus in Kay s (1954) experiment (*By courtesy of Kay and Quarterly Journal of Experimental Psychology*)

An analysis given in Table XIV, of the errors made sh increasing with both difficulty and age w

out on the card opposite the light which was on, or simply to press the key corresponding to the opposite the light which was on without using the card There is no suggestion that this simplification of the task is deliberate on the subjects' part, it would seem rather to be one way in which older people may unconsciously react to a taks which is too difficult for them

ORGANIZATION OF DATA

The concept, put forward in the previous section, of intermediate steps occurring between signal and response is similar, on a shorter time scale, to the analysis of thinking and problem solving as a stepwise process by Bartlett (1950) Recent experiments have indicated that the changes of performance with age at certain problem-solving tasks do in many ways follow the same pattern The essential feature of all these tasks is that the subject has been required to organize a number of different pieces of data together in order to answer certain predetermined questions or to arrive at a specified end result They have thus been akin to what Bartlett has called interpolative rather than extrapolative thinking

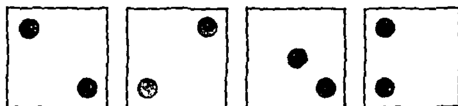


FIG 32 —*Example of a set of patterns used in Schonfield's experiment*

A fairly simple example of this kind of task is one devised by Schonfield and used by him and Shooter The subjects were presented with an apparatus having a number of hinged flaps about 3 inches square which could be raised to reveal patterns of black dots in one or more of five possible positions There were four series of four problems involving 2, 3, 4 and 5 patterns respectively An example is given in Fig 32 The task was to discover, by raising the flaps one at a time, in which of the positions (if any) a dot occurred only once Thus in the example shown the correct answer would be "top right of pattern 2 (second from left) and centre of pattern 3"

TABLE XV

TIMES AND NUMBERS OF ERRORS MADE IN A PERCEPTUAL TASK (PER SUBJECT PER SET OF 16 PROBLEMS) SCHONFIELD S AND SHOOTER S DATA

Age group	18–29	30–39	40–49	50 59	60 71
Times in seconds	264	369	410	411	415
Errors	19 8	14 3	19 1	24 3	27 0

The errors include both those of commission and of omission that is both incorrect identifications and failures to identify

Table XV shows for subjects in each decade from the twenties to the sixties the times spent and the errors made for all 16 problems taken together The times rise progressively with age, although the differences after the forties are very small The errors fall from the twenties to the thirties and thereafter rise steadily Overall

comparison between the performances of the twenties and thirties is difficult ... and the thirties

sons between performances at the different sizes of problem in relation to age. Evidence on this matter is, however, contained in the results of an experiment by Clay (1954) using a more complex problem solving task Subjects were required to place numbered ivorine counters in the squares of chequer-boards so as to add up

				13
				12
				11
				10
13	12	11	10	

FIG 33—Example of a chequer board used in Clay's (1954) experiment (By courtesy of Clay and The British Journal of Psychology)

to given marginal totals Four boards were used 3×3, 4×4, 5×5, and 6×6 The 4×4 board is shown in Fig 33 Sixteen subjects under the age of 25 years and sixteen over 55 years attempted each of the boards, 128 subjects in all Table XVI sets out the average times taken, the numbers of subjects attaining a correct solution, and the average numbers of counters changed during the course of the task (that is corrections made) On the simplest problem the two age groups gave

TABLE XVI

TIMES NUMBERS ATTAINING CORRECT SOLUTION AND ALTERATIONS MADE IN A PROBLEM SOLVING TASK DATA FROM CLAY (1954)

	Size of problem			
Age group	3×3	4×4	5×5	6×6
	Times in seconds Mean per subject			
18 24	253	256	887	1007
55–78	241	681	579	1166
	Numbers (out of 16) attaining correct solution			
18 24	15	15	11	12
55 78	14	11	7	5
	Numbers of alterations made Mean per subject			
18 24	12 4	13 8	38 2	37 1
55 78	12 6	25 9	20 1	38 7

very similar performances, but as the size of chequer board became greater there were clear signs of increasing difficulty for the older subjects Thus with the 4×4 problem they took longer time and made somewhat more corrections With the 5×5 problem there were signs that some subjects were giving up the task, times and corrections fell, and so also did the number of subjects attaining a correct solution It seemed as if the older subjects at this task had lowered their standard of accuracy and by doing so achieved an "acceptable" result in less time and with less corrections With the 6×6 problem the number of subjects attaining a correct solution was still low, but the times and numbers of corrections rose again This result would seem to indicate that an attempt was being made to maintain, by means of extra time and correction for errors, a standard of accuracy similar to that set by the subjects on the 5×5 problem

Clay indicates in her paper the nature of the errors remaining in the subjects' solutions Those characteristic of the more complex problems were such that they could not be corrected by a simple interchange of two counters, but required a more elaborate series of moves Some of the older subjects showed a tendency to concentrate on one dimension (rows or columns) and to neglect the other, or to be content to finish only some rows and columns recognizing that their solutions were incorrect and incomplete, but feeling they had done all they could

Maintenance of accuracy

The picture drawn by these experiments of the relationship between performance and age with increasing difficulty of task is thus that, up to a point, accuracy is *maintained by the expenditure of extra care and effort as shown by longer time or* more correction for errors There comes a level of difficulty however, where accuracy can no longer be maintained When this happens the subjects set a lower standard of accuracy which again they strive to maintain in the face of further increases of difficulty The break in the maintenance of accuracy comes at a progressively earlier age as the level of the difficulty of the task is raised, and at a progressively lower level of difficulty as the age of the subjects is raised

Why increasing size of problem in Clay's experiment should bring increasing difficulty with age is not clear A number of control experiments by Clay indicate that the fall with age in performance at adding found by Birren and Botwinick (1951) and by Birren and his colleagues (1954) was not a major factor Thus older subjects had little difficulty in placing 50 counters to add up to row totals on one 5×5 board, and column totals on another More important seemed to be the fact of the rows and columns both having to be dealt with on the same set of squares Dividing the problem into parts by giving a 3×3 board then adding further squares to make a 6×6 appeared to change somewhat the way in which the problem was tackled, but not to raise the final achievement of older subjects

Short-term memory

It is possible, although the evidence is by no means crucial, that some of the difficulty for older people in problem solving tasks of this kind is due to the demands they make *upon short term memory*, the suggestion being briefly discussed in connection with another problem solving task elsewhere (Welford and his colleagues) In Schonfield's experiment the role of short term memory in accumulating

the data on which a solution can be reached is obvious In Clay's experiment, where each counter has to be placed with regard to several others, there is a continual need to hold one or more in mind while dealing with others, especially when correcting errors

INTELLIGENCE TESTS

No treatment of the psychological aspects of ageing would be complete without mention of the results of applying so-called intelligence tests

Several researches on cross sections of the population have been made (Miles and Miles, 1932 Jones and Conrad, 1935, Foulds and Raven, 1948, Vincent, 1952) All show a decline in score, usually approximately linear, from the early twenties onwards The extent of the decline has varied according to the test used and in some cases (Wechsler, 1944) has been different in different sub tests Pure vocabulary and factual knowledge tests show little decline The greatest age changes are shown in tests which involve intermediate "steps" between question and answer of the type discussed previously in relation to sensori motor skills and problem solving. It would seem that there is here a very much more than superficial resemblance between intellectual and sensori motor function Somewhat less decline is shown by people of superior attainments possibly due to the tests used not discriminating well enough at the top end. Some of these tests have been carried out with time limits and Lorge (1936) has suggested that this is the main cause of the lower performance by older people However, other tests carried out without time limit show similar declines, and the evidence against Lorge's [illegible] ity to do the tasks even [illegible] ler, 1955) [illegible] by Foulds and Raven [illegible] results of which are shown in Fig 34 Matrix test scores fall with age, but the higher percentiles fall less than the [illegible] and indeed rise with age in the high [illegible] noted, namely the wide overlap of sc[illegible] people score as well as or better tha[illegible] feature of practically every study of ageing certainly of the experiments reported previously in this chapter and means that generalizations about ageing must allow for many exceptions From the practical point of view it means that practices such as rigid employment policies fixing an age bar may do an injustice to many individuals Equally, however we must be wary of making generalizations from the good performances shown by a few older people

Factors other than fall of ability

Several suggestions have been made of ways in which the test scores may reflect factors other than a fall of ability among older people Prominent are those of lack of motivation and biased sampling These, however, do not seem adequate to account for the lowering of scores with age We have already noted that lack of motivation is rare among older subjects Biased sampl[illegible] about by having to [illegible] direction to [illegible]

advances in education since they were young may have some effect, but we cannot be certain how much

This last possibility is strengthened by two longitudinal studies published recently (Owens, 1953, Bayley and Oden, 1955) Owens administered the American Army Alpha test to a group of men who had taken the same test as college freshmen (age about 19 years) some 30 years earlier Contrary to expectation he found their scores to be significantly higher on the second test than on the first Apart from the fact that Owens' subjects were of superior intellectual grade and might therefore be expected to show relatively little decline, longitudinal studies inevitably introduce the difficulty that they involve using the same or a similar test twice, Heim and Wallace (1949) have shown clearly that substantial gains in score on intelligence tests may result when the same test is taken a second time even when the subjects have no knowledge of their success or failure upon the first occasion.

The doubt raised about longitudinal studies by Heim and Wallace's results may not be entirely valid in that the first and second tests in their study were separated by only one week whereas those in Owens', for instance, were 30 years apart The effects of a single experience can, however, without doubt be long lasting, and we need to know more about such effects before we can be confident as to the meaning of results from longitudinal studies Cross-sectional studies

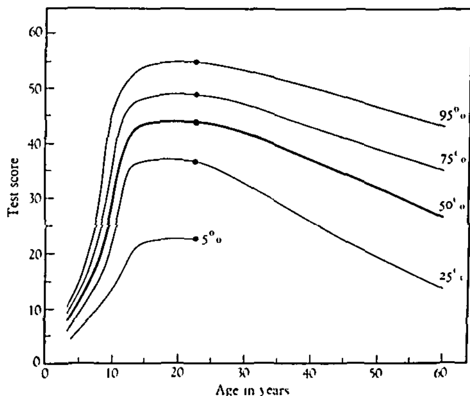


FIG 34 —Changes in matrices test and vocabulary test percentile points with age
(a) Matrices test (*By courtesy of Raven and British Journal of Psychology*)

(*see also* opposite page)

have their own, but different, objections in that they depend on the samples of different age groups being comparable in all relevant respects It is clear that neither type of study alone can be quite conclusive, and that disagreement between them may raise problems of a fundamental nature

Advantage of mental tests

Mental tests have the advantage that they are usually simple and quick to administer to large numbers of subjects but, against this, the overall scores usually yield little insight as to the nature of the ability being tested or of any difficulties encountered by special groups of subjects One way of partly overcoming this limitation has been used by Bromley (1953) with the Raven Matrices Test on middle aged and elderly psychotic patients He took careful note, not only of which items in the test were answered correctly, but also of the types of errors made and the reasons given by the subjects for their choices of answers This detailed study of performance revealed that many of the errors were due to failures similar to those noted in previous sections of this chapter, and that here was a method of testing yielding very much more insight in relation to age than that which is normally employed

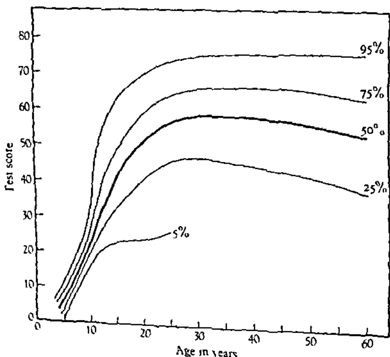


FIG 34—Changes in matrices test and vocabulary test percentile points with age (b) Vocabulary test *(By courtesy of Raven and British Journal of Psychology)* (*see also* opposite page)

advances in education since they were young may have some effect, but we cannot be certain how much

This last possibility is strengthened by two longitudinal studies published recently (Owens, 1953, Bayley and Oden, 1955) Owens administered the American Army Alpha test to a group of men who had taken the same test as college freshmen (age about 19 years) some 30 years earlier Contrary to expectation he found their scores to be significantly higher on the second test than on the first Apart from the fact that Owens' subjects were of superior intellectual grade and might therefore be expected to show relatively little decline, longitudinal studies inevitably introduce the difficulty that they involve using the same or a similar test twice Heim and Wallace (1949) have shown clearly that substantial gains in score on intelligence tests may result when the same test is taken a second time even when the subjects have no knowledge of their success or failure upon the first occasion

The doubt raised about longitudinal studies by Heim and Wallace's results may not be entirely valid in that the first and second tests in their study were separated by only one week whereas those in Owens', for instance, were 30 years apart The effects of a single experience can, however, without doubt be long lasting, and we need to know more about such effects before we can be confident as to the meaning of results from longitudinal studies Cross sectional studies

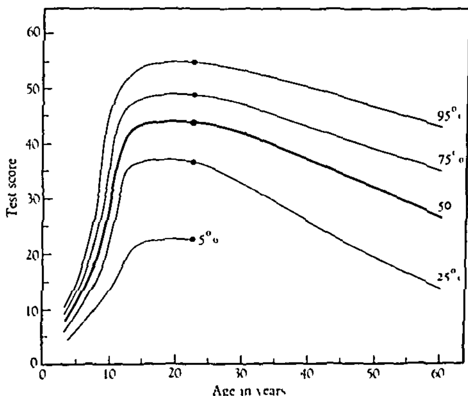


FIG 34 —Changes in matrices test and vocabulary test percentile points with age
(a) Matrices test (*By courtesy of Raven and British Journal of Psychology*)

(*see also* opposite page)

have their own, but different, objections in that they depend on the samples of different age groups being comparable in all relevant respects It is clear that neither type of study alone can be quite conclusive, and that disagreement between them may raise problems of a fundamental nature

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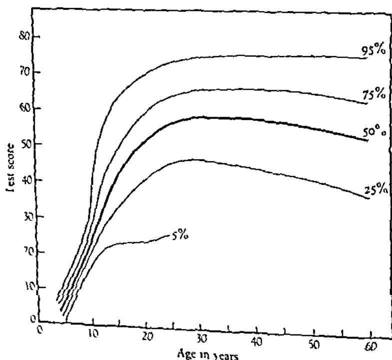


FIG 34 —Changes in matrices test and vocabulary test percentile points with age (b) Vocabulary test (*By courtesy of Raven and British Journal of Psychology*)

(*see also* opposite page)

LEARNING AND TRAINING

A considerable number of studies using a wide variety of materials have shown that performance at learning tasks declines from the late teens or twenties Early evidence is summarized by Ruch (1933) and both early and more recent evidence by McGeoch and Irion (1952) *Two main theories have been advanced to account* for the decline, both of them special cases of the main types of theory advanced to account for age changes in general The maturation-degeneration type of theory suggests that the loss of ability to learn is due to a loss of "plasticity" in the organism, presumably of nerve tissue, which makes it less easy to "register" new information The type of theory which stresses the effects of experience, points out that when we confront a new task we do so, inevitably, by bringing to bear experience and habits acquired in the past and that these may or may not be appropriate, and will help or hinder performance accordingly

This second theory implies either that the wider range of experience that older people can be expected to possess, or the greater extent of its channeling increase the chance of their bringing inappropriate experience to bear The main protagonists have been Thorndike and his colleagues (1928), and Ruch (1934) The latter *compared the performances of subjects of different ages learning by rote* (a) meaningful associates of the type, HOUSE VISIT, (b) nonsense equations such as $A \times M = B$, and (c) false equations such as $3 \times 4 = 2$ He found a greater decline with age on (b) and (c) than on (a) The results are given in Table XVII

TABLE XVII

LEARNING OF DIFFERENT TYPES OF MATERIAL DATA FROM RUCH (1934) NUMBERS OF CORRECT RESPONSES OUT OF 150 MEAN PER SUBJECT

	Type of material		
Age range	*Meaningful associates*	*Nonsense equations*	*False equations*
12–17	134 7	78 5	106 1
34 59	123 7	62 8	76 1
60–82	111 6	37 9	49 4
Ratio 60–82/34 59	0 9	0 6	0 65

Ruch maintained that these results showed that the greatest decline was on (c) that is the task which ran counter to established experience, and thus confirmed his theory The figures do however, show the percentage decline for (c) to be very similar to that for (b) The evidence for Ruch's view is, in fact, far from conclusive and other possibilities need to be considered For instance, nonsense and false equations require more learning than meaningful material in the sense that with the latter one part does to some extent imply the other Ruch's results might,

herefore, be due to older people finding learning progressively harder as the amount to be learnt is increased.

Stages of learning

Now for learning to take place, and for the subject to be able to furnish evidence that it has, a number of stages have to be gone through. These will vary somewhat from one situation to another but the following would seem to be essential

(1) Perception and comprehension of the material to be learnt

(2) Some form of short-term storage of the material for long enough to enable longer-term retention processes to take place

(3) Retention by means of some more or less enduring biochemical or structural change

(4) *Recognition* of a further situation demanding the re-use of this particular material rather than any other.

(5) Recall of the material retained

(6) Its use, with adaptation if necessary, in the new situation

These stages would seem to be essential whatever type of theory of learning we hold and apply equally to the "specific trace" type, and to the more schematic approach of Bartlett (1932)

The plasticity hypothesis

The plasticity hypothesis assumes that failure on the part of older people lies in stage 3. It must be emphasized however that usually all we measure is stage 6 and that failure at this stage could be due to failure at any previous stage. In particular, the work surveyed in previous sections of this chapter would lead us to expect that the material may sometimes fail to be comprehended at stage 1. This is especially likely when the pace at which the material is presented is not under the subject's own control as, for instance, when listening to a training lecture. In such circumstances, any slowness of comprehension will cause parts of the material to be missed. Again, any impairment of short-term retention at stage 2 would hamper the forming of longer term memories but without any reason to assume loss of plasticity.

Transfer of previously acquired habits

The hypothesis that age changes in learning are due to the transfer of previously acquired habits implies that the breakdown with age occurs at [illegible]
[illegible]
sc [illegible]
t [illegible]
c [illegible] about a situation with which he is confronted, whether or not he remembers what he is supposed to have [illegible]
If he h [illegible]
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ap [illegible]
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older people—air [illegible]
one among many [illegible]

Errors early in learning process

Kay (1951) has produced evidence that errors introduced early in learning may be very difficult for older people to overcome. His subjects were required to learn to press a series of morse keys in order. In spite of the fact that each correct key in the series had always to be found before passing on to the next, subjects, especially those in their fifties and sixties, would go through the series again and again making the same errors. It seemed as if they acquired some idea of the sequence during the first trial or two which was very difficult to modify later at the points where it was wrong

The practical implications of Kay's experiment and of the preceding discussion is that it would seem worth taking special care when training older people to ensure that they comprehend the material to be learnt right from the start, and are never faced with having to perform the task they are learning with gaps in their knowledge This may require—to name a few possibilities—special methods of instruction, a more leisurely pace of teaching, giving the subject control over the speed, or individual attention Care given to the early stages of training in this way would seem likely to be well repaid by quicker mastery in the end

Learning for "use"

E. Belbin (1953) has obtained evidence which suggests that it may not be quite fair on older people to measure retention by how much they can state in words of what they have learnt She presented subjects in their teens and twenties, and over 60 years of age, with road safety posters and measured retention of them by (a) asking for recall in words, and (b) asking for comments on photographs of road scenes illustrating points made in the posters The subjects over 60 years old were markedly poorer than the younger subjects at (a), but about the same as them at (b) Both younger and older subjects in a control group given the photographs for comment without having seen the posters made less relevant comments than subjects who had seen the posters It thus appears that the posters did affect comment upon the photographs and also that the older subjects who had seen them had in fact learnt and could use the points made in them although not able to recall them in words Such a finding is not without parallel, it is, for instance, commonly recognized that people with high degrees of manual skill or fine judgement are often unable to state their methods in words

Incidental learning in relation to age

An opportunity was taken in January 1953 by Speakman (1954) to carry out a field experiment on incidental learning in relation to age On 3 May 1951 the colours of most British postage stamps were changed The former colours and designs of the stamps were retained but the colours were assigned to different values, except in the case of the 3d which was unchanged Speakman removed the numbers indicating the values of the ½d , 1d , 1½d , 2d , 2½d and 3d stamps (which are all of the same general design), presented subjects with the six stamps on a card and asked them whether they could identify the values of the stamps in present use They were then asked if they could remember the values borne by the various stamps before the change of colour Sixty-seven subjects were used, with ages well spread over the range from the twenties to the eighties Philatelists, office workers

and others handling large numbers of stamps were excluded Results are shown in Table XVIII Although the younger subjects could remember more of the obsolete values, they were very little better than the oldest subjects in their knowledge of the new values

TABLE XVIII

RECALL OF STAMP VALUES DATA FROM SPEAKMAN (1954) MEAN OUT OF 6 PER SUBJECT

Age range	20 29	30–39	40–49	50–59	60–69	70–86
Old series	4 8	4 7	4 3	3 0	2 3	2 2
New series	3 4	2 9	1 9	2 2	2 5	2 4

This rather surprising results and that of E Belbin suggest that older subjects may be relatively better at learning ' for use'' than learning the rather artificial tasks commonly set them in psychological experiments

Industrial training for older people

The most obvious practical interest attaching to studies of learning by older people is the question of how far they are able to take up new jobs in late middle or early old age, if disease, failing capacities or changes of industrial process make it necessary for them to do so Direct studies of training in industry, however, present many difficulties Very few middle aged and older people are trained records of [illegible]
and, most s [illegible]
people whc [illegible]
of status co [illegible] younger trainees

TABLE XIX

RESULTS OF RE TRAINING TRAM DRIVERS AS BUS DRIVERS SHOOTER'S DATA

Age group	26–30	31–35	36–40	41–45	46–50	51 55	56–60	61–67
Number of persons	104	106	146	92	63	62	61	60
Percentage passing in 3 weeks	96	97	90	83	65	71	44	32
Percentage passing in 4 weeks	3	2	9	12	23	8	25	10
Percentage passing in 7 weeks	1	1	—	2	5	11	24	21
Total percentage passing	100	100	99	97	93	90	93	63

Re training of London tram drivers

Such evidence as there is suggests that the main trends shown by laboratory studies apply also in the field One of the best sets of data is from the re training of London tram drivers as bus drivers when trams were withdrawn from service Figures are given in Table XIX The numbers passing in 3 weeks show a continuous fall after the early thirties indicating an increase of difficulty with age

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Most recent work on learning has been concerned with learning *achievement* The actual details of the *process* whereby this achievement is attained have been almost entirely neglected The work surveyed here, especially that of Kay (1951), emphasizes that consideration of the detailed processes of learning yields insight not readily attainable in other ways and would seem an essential step to further progress, not only in work on ageing but for studies of learning in general

CONCLUSION

Most of the changes of performance with increasing age that have been surveyed in this chapter have the depressing characteristic of being downward with the years Wechsler (1935) has pointed out in a vigorous passage how unpopular such findings can be The unpopularity is understandable and is, perhaps, one of the reasons why no programme of research on the psychological aspects of ageing has yet survived beyond a few years

The results of research do perhaps unduly stress declines with age, obviously there are respects in which a man or woman mature and ripen with the years The difficulty is that these are subtle aspects of human functioning and the techniques that exist for the measurement of beh
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time pointed to a number of conditions under which achievement does not seem to decline It has thus done something to *delimit* areas of change and to specify conditions which act to the disadvantage of older people *and also to those which do not* If we cannot yet point to ways of reversing age trends, we can at least show how their effects may be minimized This is a more modest aim for a study of ageing but is, surely, more realistic

Suggestions have been made elsewhere (Welford, 1953, 1955) as to how some of the points mentioned here might apply to employment problems
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Gifted Adults *J Geront.,*
Belbin E (1953) The Eff
Unpublished
Belbin R M (195

at learning the new task. Most of those who fail at 3 weeks do, however, pass by 7 weeks so that in the number who pass eventually there is little fall until the sixties. Even at this age two thirds of the trainees pass. Experience of driving other road vehicles clearly helped, as shown in Table XX. Very few of those with this previous experience failed. Such experience was not necessary, however, as is shown by the substantial numbers even as late as the fifties who passed without it.

TABLE XX

RELATIONSHIP BETWEEN SUCCESS OF TRAM DRIVERS RE-TRAINING AS BUS DRIVERS AND PREVIOUS EXPERIENCE OF DRIVING OTHER ROAD VEHICLES. SHOOTER'S DATA

	Age range			
	Twenties and Thirties	*Forties*	*Fifties*	*Sixties*
Trainees passing in 3–4 weeks				
Experience with				
Trolley bus - - - -	2	—	13	10
Car or lorry - - - -	43	11	15	8
Both kinds - - - -	4	1	1	—
No experience with other road vehicles - - - -	17	9	22	3
Trainees failing or discontinuing				
Car or lorry (none with trolley-bus) - - - - -	—	—	1	3
No experience with other road vehicles - - - -	2	7	11	16

NOTE. The numbers in this Table differ from those in Table XIX because data regarding previous driving experience were collected from only some of the trainees.

A number of miscellaneous points about training may be briefly noted. Data from training courses have indicated a tendency for older trainees to find greater difficulty with theoretical than with practical instruction, the data have varied somewhat as to the age at which difficulties have appeared. R. M. Belbin (1953) found that in the sample of operations he studied, difficulty in training older people appeared on operations which were in nearly every case different from operations where older people had difficulty in maintaining performance. The former were typically skilled or semi-skilled operations involving some degree of pressure for speed and demanding the acquisition of rhythm. The latter, as has been mentioned earlier, typically required continuous bodily activity in a task paced by the machinery used. King (1955), from the replies to a questionnaire, found that older instructors of rural craftsmen tended to rate the performances of older trainees higher than did younger instructors. He raised the question of whether this, if not simply due to older instructors looking kindly upon their contemporaries, may imply an advantage in using older instructors to train older men.

Requirements for further research on learning

Learning in relation to age and the training of older people are problems upon which research is still very little developed. The reason for this is probably that the main lines of psychological thought in the past few years have not produced theories about learning which show much immediate relevance to these problems

Most recent work on learning has been concerned with learning *achievement* The actual details of the *process* whereby this achievement is attained have been almost entirely neglected The work surveyed here, especially that of Kay (1951), emphasizes that consideration of the detailed processes of learning yields insight not readily attainable in other ways and would seem an essential step to further progress, not only in work on ageing but for studies of learning in general

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The results of research do perhaps unduly stress declines with age, obviously there are respects in which a man or woman mature and ripen with the years The difficulty is that these are subtle aspects of human functioning and the techniques that exist for the measurement of behaviour are not yet sufficiently developed to enable us to deal with them Although the research outlined here has shown many performances to decline from early or late middle age, it has at the same time pointed to a number of conditions under which achievement does not seem to decline It has thus done something to *delimit* areas of change and to specify conditions which act to the disadvantage of older people *and also to those which do not* If we cannot yet point to ways of reversing age trends, we can at least show how their effects may be minimized This is a more modest aim for a study of ageing, but is, surely, more realistic

Suggestions have been made elsewhere (Welford, 1953, 1955) as to how some of the points mentioned here might apply to employment problems in industry To some extent they show the way to selecting older people for jobs, but to a much greater extent they point to the possibility of modifying jobs to make them more suitable for older people For instance, the effective maximum limit of speed might sometimes be transferred *from the man to the* [illegible]

[illegible] extent to which it helps an older man [illegible] are detailed ones and [illegible] They do, how[illegible] psychologist, [illegible] and the work design engineer

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CHAPTER 5

ARTERIOSCLEROSIS AND HYPERTENSION

F H Smirk

INTRODUCTION

Arteriosclerosis is not a single pathological entity The term describes a number of interrelated pathological processes and clinical conditions which it is convenient to group together Arteriosclerosis sometimes causes elevation of the blood pressure and there is good evidence that hypertension accelerates arteriosclerosis Where arteriosclerosis and hypertension coexist in old people their respective clinical manifestations may be modified and decisions concerning treatment are influenced by the presence of the two conditions

What follows concerns the nature and the clinical potentialities of arteriosclerosis No attempt will be made to describe its regional manifestations in detail

ARTERIOSCLEROSIS

The various pathological processes in arteriosclerosis cause changes in gross structure, *in the histology and in the physical properties of blood vessels* The changes may be advanced yet asymptomatic In arteriosclerosis, both subjective and objective impairments occur from decrease in the lumen of one or more arteries, either as a direct result of arteriosclerosis, by the secondary development of thrombosis, or by embolism which may follow a proximal arterial thrombosis Additionally, there may be haemorrhage from rupture of an arteriosclerotic artery, or rupture of the inner part of the arterial wall leading to dissecting aneurysm Expansion of the wall of the damaged vessel into an arteriosclerotic aneurysm may also occur

Pathology

The complicated pathology of fully developed arteriosclerosis appears to have components, each of which is, exceptionally seen almost uncomplicated The component pathologies usually occur together, but the proportions in which the morbid processes are found vary and depend on which artery is involved

Arterial fibrosis

With increasing age there is usually a decrease in the muscle and elastic tissue of the aorta and large vessels with fibrous replacement Often the arteries are stretched and become *wider and as they elongate there is tortuosity which may be* well seen in the aorta, the brachial and temporal arteries Radiologically the abnormal curves of an elongated thoracic aorta may simulate single or multiple aneurysms This process may be associated with atheroma but is not dependent

upon it Although stretched, the vessels are less elastic and more resistant to further distension This structural change is likely to be more severe in patients with hypertension, probably from the added mechanical strains Generalized fibroid replacement of this type involves the aorta, large and medium arteries [illegible]

[illegible] injury from the intimal lipoid accumulation in atheroma. The occurrence of this combination is implied in the term atherosclerosis

Monckeberg sclerosis

It has been mentioned already that a diffuse fibrosis may involve the media [illegible] suggested that the gravitational increment of [illegible]

arteries are not involved uniformly, there being rings of calcification and fibrosis, so that when a finger is run along the length of an artery, for example the radial, the feeling is rather like running a finger along a trachea This condition is not regularly associated with narrowing of the lumen of the blood vessels though this may happen if atheromatous degeneration is also present, or if thrombosis occurs Hence Monckeberg sclerosis may or may not be accompanied by clinical evidence of impaired circulation, such as intermittent claudication or gangrene Calcification of the vessels may be observed radiologically and the characteristic rings round the vessels may be seen

Atheroma and atherosclerosis

Atheroma probably begins as a metabolic disease, the essential lesion being a deposition of lipoid beneath the endothelium Deposition continues through the years usually without causing serious ill effects, until middle age or later The deposits are found in the aorta, in large and medium sized arter[illegible] small arter[illegible] the inti[illegible] The ve[illegible] cholesterol or fat content of the diet, [illegible] cause the intima to project into the [illegible] region of the atheromatous projection there is a local fibrosis and increased vascularity of the arterial wall and sometimes minute haemorrhages In the course of time the intima is likely to rupture in many places and the porridge like material is extruded into the blood stream leaving atheromatous ulcers The atheroma when extensive, may cover much of the intimal surface of the aorta, with much fibrosis, calcification and plaque formation The intimal elastic tissue may become fragmented and spread out through the atheromatous deposits The aorta and some of the larger vessels are likely to be

stretched as well as hardened In medium sized arteries, however, the hypertrophied intima, projecting into the lumen, may cause eccentric narrowing of the vessel and sometimes virtual obliteration Thrombi *forming on an atheromatous* ulcer also may obstruct a blood vessel Thrombosis may be succeeded later by some canalization of the obstruction

Obliterative endarteritis

This condition is not always included with arteriosclerosis It consists of intimal thickening with obliteration of the lumen and occurs in the senile involution of organs such as the ovaries and uterus, and in the walls of abscesses

PATHOGENESIS OF ATHEROMA AND ATHEROSCLEROSIS

In atheroma the fatty deposits beneath the endothelium are composed of phospholipid and cholesterol Cholesterol fed to rabbits and to chickens but not to normal dogs, causes the formation of atheromatous deposits in blood vessels The arterial lesions in rabbits and chickens are more severe when hypertension is also induced (Dill and Isenhour, 1942, Katz, 1951) Atheroma can be induced also by dietary means in dogs which have been rendered myxoedematous (Moses, 1954), especially when they are hypertensive

Influence of diet in severe atherosclerosis

In man there is impressive evidence that the occurrence of severe atherosclerosis is much influenced by diet Diets high in fat and cholesterol favour, where is diets low in fat and cholesterol hinder, the development of atherosclerosis In practice diets high in fats are usually high in cholesterol, hence it has been difficult to decide if the atherogenic factor is high fat, high cholesterol or a combination of both *High calories and amount of protein may be important*

High blood cholesterol and development of atheroma

In man there seems to be some association between a *high blood cholesterol and* the development of atheroma However, diminution or increase of the cholesterol content of the diet does not alter greatly the cholesterol content of the blood (Keys, 1952) *Much of the cholesterol is formed endogenously* so that elimination of dietary cholesterol does not of necessity prevent its accumulation On the other hand there is an important relationship between the fat content of the diet and the blood cholesterol, diets very low in fat being associated with lower blood cholesterol and high in fat with higher blood cholesterol, even when the cholesterol content of the diet is kept constant (Anderson and Keys 1953) In Spain Keys (1953) found the serum cholesterol values much lower in poor men on a low fat, low cholesterol diet (about 22 per cent of calories from fats) than in prosperous men on diets similar to those eaten by wealthy men in the United States Corresponding observations on the relation between diet and serum cholesterol have been made by *others (Hildreth and his colleagues, 1951, Katz, 1951)*

It has been realized for some time, and the evidence has been much strengthened lately (Keys, 1953), that populations consuming little fat have comparatively

little atheroma and the incidence of and mortality from cardiac infarction, cerebral haemorrhage and hypertension seems to be much reduced

Effect of war time diet

Malmros (1950) stated that, during the deprivations of the war years, the reduced consumption of eggs, butter and other foods rich in cholesterol was associated with a decrease in the mortality from arteriosclerosis The decrease was most prominent in the urban population which did not get food outside the official ration The relations between the incidence of atherosclerosis and diet were the subject of discussions at the second World Congress of Cardiology in Washington (September, 1954) From contributions by Doctors Paul White, Ancel Keys Gunn[illegible]
Spain and Japan [illegible]
manifestations is [illegible]
Comparing two Italian cities, Naples and Bologna the dietary fat content and the incidence of atherosclerosis are higher in the latter In New Zealand, where the fat content of the diet is high arteriosclerotic conditions are prevalent and there is a particularly high incidence of coronary artery disease

Lipoproteins and atherosclerosis

Barr (1953) has directed attention to the increase of β lipoproteins and decrease of α lipoproteins and albumin in patients with atherosclerosis as compared with normal persons The β lipoproteins have a cholesterol phospholipid ratio, by weight of over 1 00 whereas the ratio for α lipoproteins is about 0 50

Barr (1953) found that the administration of oestrogens to survivors of myocardial infarction in large doses suff[illegible]
in men led to changes in the plasma li[illegible]

[illegible]

Some interesting observations have been made on the effect of intravenous heparin upon the serum lipoids *In vitro*, the turbidity due to plasma lipoids is unaffected by heparin but, when injected intraven[illegible]

[illegible] heparin causes the formation of a lipoid-clearing principle There is evidence that [illegible]

[illegible] by heparin administration We must [illegible] a convincing demonstration in animals that heparin is able to prevent dietary atheroma

Gertler Garn and Lerman (1952) consider that the ratio of cholesterol to phospholipids is higher in patients with coronary disease and the deposition of cholesterol in the intima may be related to this ratio

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Gertler, Garn and Lerman (1950) ... the ratio of cholesterol to ... disease and the deposition of

Gofman and his colleagues (1950) consider that arteriosclerosis is not due to changes in the serum cholesterol level as such They find that in human serum there is a mixture of lipoproteins and lipids which may be separated into fractions by means of an ultracentrifuge The rates of migration of various molecules have been classified in units described by Svedberg It is found that the serum concentration of higher molecular weight molecules which, in the ultracentrifuge, migrate with rates of 10–20 Svedberg units, seems to be related to the presence of atherosclerosis in man These particular lipoid fractions compose but 10–15 per cent of all serum liproproteins and about the same percentage of total serum cholesterol, but they are said to constitute a fraction which is found in excess in cases with coronary disease, with diabetes, the nephrotic syndrome, myxoedema and xanthoma tuberosum

Stamler (1952) found that both plasma cholesterol and lipoproteins of grades 10–20 are depressed by feeding diets low in fat and cholesterol Gofman and his colleagues (1952) find the incidence of atherosclerosis much more significantly related to the Sf 12–20 and 20–100 lipoproteins than to the total serum cholesterol Keys (1952), however, holds the view that it is at present uncertain which of these factors is the more important Dock (1953) also regards the matter as unsettled

Duguid (1948, 1954) considers that some of the atherosclerotic lesions in the aorta and coronary arteries are the result of mural thromboses which may be macroscopic or only seen with magnification In other instances he considers that the primary phenomenon is the deposition of lipoids from the blood stream upon the endothelial surface of the intima In either case the abnormal deposit of fibrin or of lipoid becomes covered with endothelium, and later fibrous tissue is laid down and the appearance becomes one of subendothelial fibrosis Duguid (1954) in his later paper points out that re canalization of a thrombosed coronary artery may give rise to appearances which are indistinguishable from atherosclerosis but which in adjacent parts of the artery are evidently the result of thrombosis Harrison (1948) obtained support for Duguid's contention by experiments in which he injected fibrin into the pulmonary arteries of rabbits Arterial changes followed which were indistinguishable from those of atherosclerosis Duguid thinks that most examples of atherosclerosis in which the vessel lumen becomes narrowed are the results of thrombotic lesions

An understanding of the relationship between lipoids and atherosclerosis is further complicated by the observation that under certain circumstances the clotting time of blood may be accelerated by a fatty meal (Fullerton and his colleagues, 1953, Waldron and his colleagues, 1951) This observation is of considerable interest in relation to Duguid's hypothesis, but it must be pointed out that changes in the coagulability of blood are not necessarily related to intravascular thromboses

CONDITIONS PREDISPOSING TO ARTERIOSCLEROSIS IN GENERAL

Associated conditions and incidence

The incidence of arteriosclerotic processes is higher than the average in diabetes and in hypertension, and a higher incidence may also be associated with obesity

Heredity influences the disposition to atheroma in part perhaps because the occurrence of diabetes hypertension and obesity are influenced genetically

Heredity

It has been suggested that heredity influences the particular part of the body in which atherosclerosis causes clinical manifestations Examples occur in the literature of families with a very high incidence of cerebral accidents also there are families where coronary disease is prevalent But such manifestations of [illegible]

[illegible]

frequently associated with early occurrence of atheroma

Mechanical strains

There is evidence that the [illegible]

[illegible] to an arteriovenous fistula (Dock 1950) the aorta proximal to the narrow [illegible]

[illegible] of the aetiology of the hypertension

CLINICAL CONSEQUENCES OF ARTERIOSCLEROSIS

Systolic hypertension

Arteriosclerosis causes a decrease in the elasticity of the aorta and thereby a rise in the systolic blood pressure but without important increase in diastolic pressure The systolic discharge of blood from the heart must first be accommodated in large vessels hence when there is a decrease of elasticity and distensibility, the systolic pressure must rise to an abnormally high level before the vessels stretch enough to accommodate the systolic discharge

Most of the important consequences of arteriosclerosis arise from intimal atherosclerosis and apart from systolic hypertension notable complications are rarely attributable to the fibrous replacement of muscle and elastic tissue

Arteriosclerotic aneurysms

Arteriosclerotic aneurysms are rare in the thorax but not so infrequent in the abdomen Arteriosclerotic aneurysms may occur also in major arteries such as the femoral popliteal innominate and subclav[illegible]

[illegible] are sometimes only an inch or [illegible] out they may split the whole length of the aorta and by occluding branches of the aorta may cause a variety of physical signs including sometimes loss of function of the spinal cord absence of pulsation in a leg or interference with the renal circulation They are usually but not invariably associated with

intense pain, and may be difficult to distinguish from a cardiac infarction though electrocardiographic changes, if present at all, are less striking in dissecting aneurysm

Almost any of the medium or large branches of the aorta may be occluded as the result of arteriosclerotic processes Often the occlusion is due, in part, to superadded thrombosis Rarely the aorta itself may be blocked in this way. When this exceptional event occurs it is usually in the abdominal aorta

Atherosclerosis

The coronary arteries are pre-eminently vulnerable to intimal atherosclerosis. Sometimes when there have been clinical manifestations of coronary atheroma little deterioration may be found in other arteries, and indeed the coronary disease itself may not be extensive In addition to causing angina, coronary insufficiency, cardiac infarction and cardiac aneurysm, atheromatous coronary disease may lead to cardiac enlargement, heart failure, branch bundle block, complete heart block and various ectopic arrhythmias dependent on abnormal impulses arising from damaged heart muscle Atherosclerotic processes may also involve the mitral or aortic valves and be responsible for cardiac murmurs beginning in later life

Atherosclerotic processes may involve cerebral arteries over half a millimetre in diameter Thrombosis, haemorrhage or atheromatous narrowing of vessels may cause such conditions as hemiplegia, Parkinson's disease and dementia Often arteriosclerotic processes in the brain are more extensive than has been suspected in life and much of the process of ageing can be attributed to decrease of cerebral function from ischaemic brain atrophy.

In the abdomen, thrombosis of a mesenteric artery may result from arteriosclerosis and cause gangrene of a segment of the gut, and renal atherosclerosis causes nephrosclerotic changes which are not necessarily associated with hypertension Occasionally atherosclerotic processes in other abdominal vessels lead to clinical manifestations

Arteriosclerosis of the lower limbs

Arteriosclerosis in the lower limbs is frequent Sometimes a length of major artery is narrowed but often there is a comparatively short block The latter condition is less severe as it is easier for anastomotic channels to bridge the gap The location of blocks by intra-arterial injection of contrast medium has become important because of the possibility of restoring the circulation by arterial grafts, which may be applied to major limb arteries or occasionally even to an aorta or to iliac arteries Obliterative arteriosclerosis in the lower limbs may cause intermittent claudication, atrophy, coldness of skin, wasting of muscles and gangrene Ischaemic limbs are more vulnerable to mechanical and thermal injury Where there is important arteriosclerosis in limb vessels, pulsation will be absent in either the femoral, popliteal or posterior tibial arteries Sometimes the dorsalis pedis artery is impalpable normally In the lower limbs, as in other parts, thrombotic occlusion of a vessel may precipitate the manifestations of ischaemia

PREVENTION AND TREATMENT OF ARTERIOSCLEROSIS

Diet

It may be that nothing can be done in old age, but there are interesting speculations to consider Of importance is the high probability that atherosclerosis may be combatted by diets which are sufficiently low in fat and cholesterol (for example fat calories are 20 per cent of total calories), but the smallest effective degree of fat restriction is unknown

Practical experience with diets, strikingly low in fats and cholesterol, relate to very poor communities, and malnutrition and other adverse factors are involved Nevertheless, if low fat and low cholesterol are, as they seem to be, the essential features of such diets, it should be possible to devise adequate diets which are not atherogenic by the addition of lean meat and fish Such diets may, of course, have unforeseen disadvantages Though proof is lacking, there might well be a better expectation of life extension and activity among prosperous middle aged people, especially males, were their calories regulated to preserve a low normal body weight with fat calories maintained between 25 and 30 per cent of total calories

In older people the expectation is that much atherosclerotic damage has been done but there may be instances where the strict regulation of fat intake is worthwhile in later life Gofman and his colleagues (1952) reported that cardiac infarction rec[illegible] a low level in the serum of the [illegible] as found possible to achieve a [illegible] results have been reported by Morrison (1951) Hence, it may be that further extension of arterial damage can be retarded sometimes by diet

Although it has not been proved that limitation of fat intake is beneficial in elderly people, there is an expectation that it may be advantageous Suitable patients, particularly those who are deliberately seeking to preserve life and activity [illegible] fat [illegible] inta[illegible] may c[illegible] dietar[illegible] artery [illegible] largely of lean meat, non fatty fish (cooked without fat), green vegetables (without additions of butter) and fruit Toast, marmalade, jams, cereals, are allowed Butter, cream, fat meat, eggs, pastry and fried foods or much milk are either removed from the diet or greatly reduced The total calories should be adjusted to reduce obesity or preserve an ideal weight

Control of blood pressure levels in hypertension

Control over blood pressure levels in hypertension may retard the development of the type of arteriosclerosis characterized by diffuse fibrosis of arterial walls with decrease of their elasticity But this is the least important of the arteriosclerotic changes which are present in old age groups, the pathological and clinical sequelae of intimal atherosclerosis cause much disability and shorten life As hypertension accelerates atherosclerosis, reduction of high blood pressure may

retard it but a practical test of this has not been made in man and it would involve a long and exacting investigation

Regional manifestations of arteriosclerosis

Use of anticoagulants

It is beyond the scope of this chapter to consider specifically the treatment of regional manifestations of arteriosclerosis such as cardiac infarction or gangrene of limbs It seems relevant however to the general topic of arteriosclerosis to mention the use of anticoagulants The extent to which thrombotic complications of atheroma can be prevented by anticoagulant therapy is disputed and may depend to an important extent upon the efficiency of supervision The figures of Tullock and Irving Wright (1954) are impressive We have not engaged extensively in long term anticoagulant therapy but some of our results encourage us to go further The extent to which long term anticoagulant therapy can be applied in middle aged and elderly people involves questions of policy and organization as well as clinical opinions on individual patients

HYPERTENSION IN ELDERLY PEOPLE

For the restricted purpose of this chapter hypertensive patients are described as elderly who are aged 70 or over or who are over 60 and appear to have aged considerably in that they have become tired or decrepit or show structural changes appreciably beyond their years In such patients the manifestations of hypertension are likely to be associated with symptoms arising from arteriosclerosis and from other disorders which occur in older people In the older age group as defined special problems in therapy arise

Normal and abnormal blood pressure

Representative blood pressure levels

Probably the boundary between normal and abnormally high pressures cannot be described numerically Crude statistics of blood pressure levels in groups which appear to be representative of the general population show a rise in the casual blood pressure with age up to about the 70 s or 80 s after which mean blood pressure levels drop a little due possibly to a selective removal by death of those with higher blood pressures The rise with age is only partly due to the inclusion of an increasing number of hypertensive persons in the older age groups Even were all persons with blood pressures above 140/90 to be regarded as hypertensive and not counted an increase of the mean blood pressure with age is to be observed But were 140/90 or even 160/90 to be considered as the lower limit of hypertension in old people a large number of elderly persons many of them in excellent health become classified as hypertensives

"Normal" blood pressure

Most attempts to demarcate the boundary between normal and abnormal blood pressures are arbitrary and have no statistical meaning A logical way of defining

"normal" (in the sense of usual) was suggested by Master and his colleagues (1952) who defined the limits of "normal" blood pressure for each decade and sex group as 1 282 standard deviations above and below the mean blood pressure for that decade and sex This definition is valuable because it indicates clearly which blood pressures lie within the ordinary range and which are unusually high or low But "normal" as defined by Masters is, as he himself points out, not "ideal" and the limits he described would, I think, be better referred to as "usual"

Effect of blood pressures above and below average

The statistics of life insurance companies and many clinical statistics indicate clearly that of people whose blood pressures lie within the ranges of "normal" as described by Master, those whose blood pressures are in the lower end of the range are much less likely to develop cardiac failure and cerebral vascular accidents than are those whose blood pressures lie at the upper end of the range There is, in fact, no level of arterial pressure above which it can be said that pathological changes secondary to the pressure occur and below which they do not occur While moderate elevation of the blood pressure, say 170/95, appears to have, statistically speaking, an adverse influence on the cardiovascular system and on the prospects of a cerebral vascular accident, the fact remains that the eventual occurrence of these complications may be long delayed Of a group of elderly persons with blood pressures which are above the mean many will survive for years, but when eventually they become disabled or die their chance of this occurring as the result of some condition secondary to hypertension and arteriosclerosis is much greater than it is in persons whose blood pressures are under the average It is not unreasonable to believe that, had they not succumbed to a hypertensive condition, disability or death might have been postponed Further evidence on this matter is to be obtained by noting the effects of hypotensive treatment

CASUAL BASAL AND SUPPLEMENTAL BLOOD PRESSURES

Casual blood pressure

The casual blood pressure as ordinarily measured in hosp[illegible] doctor's [illegible] blood [illegible] bears [illegible] and mortality

It should be generally recognized that in many persons the doctor and his sphygmomanometer are potent pressor stimuli and the good prognosis of some patients whose blood pressures [illegible] that their blood pressures are ne[illegible] at home In such patients the c[illegible] pressure in so far as it concer[illegible] decided in terms of ordinary n[illegible] blood pressure Many elderly patients who exhibit high casual blood pressures are of this labile type, others have fixed high blood pressures

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Basal and supplemental blood pressures in elderly hypertensives

In about 700 estimations of the basal blood pressures in hypertensive individuals it was found that, in groups of patients with approximately equal casual blood pressures, adverse clinical manifestations are much more frequently associated with high than with low basal blood pressures. We therefore regard a high basal

course be considered concurrently. It seems probable that some of the patients who have had a high casual blood pressure for periods of 15 or 20 years, without great impairment, are patients of the type referred to previously with low basal blood pressure who exhibit the blood pressure elevation mainly on the occasions of visits to the doctor. It is almost certain that under quiet conditions at home, and when sleeping, the blood pressure level of such patients is much nearer to normal than when it is measured in a doctor's office.

PATHOGENESIS OF HIGH BLOOD PRESSURE IN ELDERLY PERSONS

Essential hypertension

It is beyond the scope of this chapter to discuss the pathogenesis of less common causes of high blood pressure. The pathogenesis of essential hypertension as it occurs in the elderly is of great interest. The author has expressed the view previously that the unity of the clinical picture in essential hypertension is not

proce

all th

either

... s, so that the total

... clinical manifestations of essential hypertension are consistently relieved by the effective use of hypotensive agents, and in nephritis, Cushing's syndrome and other conditions with secondary hypertension there is corresponding improvement of

Component causes of blood pressure elevation

If we accept such a view essential hypertension is no longer one big mystery but several small ones. The starting point of the disorder or syndrome is, as its name

Basal blood pressure

The term basal blood pressure was first used by Addis (1922) to denote blood pressures taken in the morning under resting conditions Later, basal blood pressure was defined by the Cardiac Society of Great Britain and Ireland and the American Heart Association as the blood pressure taken in the morning after a preparation of the patient similar to that used for basal metabolic rates Alam and Smirk (1943) showed the need for deliberate emotional desensitization of the subject to the presence of the observer and to the procedure of sphygmomanometry, a procedure was recommended later (Smirk, 1944) which combined the method of emotional desensitization with the recommendation of the British and American Cardiac Societies Many observations on elderly people show that in the old, as in the young, the basal blood pressure may be either much or but little below the casual blood pressure During the last twelve years estimation of the basal blood pressure has been a routine procedure in our hypertension clinic and has proved to be one of the most valuable investigations

Measurement of basal blood pressure

The technique of measurement is of paramount importance for either physical or emotional disturbance can prevent the attainment of a basal state Basal blood pressures have been determined in the following way Patients are informed that the aim of the investigation is to determine the blood pressure under very quiet resting conditions They are assured that it is not the prelude to any disturbing or troublesome procedures They are told they must lie quiet during blood pressure measurements which are to be made next day, and must keep the mind blank They must not turn over life's problems and difficulties, nor converse with the observer They are admitted overnight to hospital and given 1½ or 3 grains of pentobarbitone to promote sleep Overnight they fast for a total period of 10–12 hours Next morning they are transferred in bed to a quiet warm room where they are given an additional 1½ to 3 grains of pentobarbitone and rest for a period of half an hour At the end of this time the observer enters quietly, adjusts the sphygmomanometer and measures the blood pressure The measurement of blood pressure is then continued without intermission at intervals of half a minute for a further period of approximately 20 minutes or half an hour in order to secure whatever additional fall of blood pressure can be obtained by emotional desensitization It is found that as patients become habituated to the procedure the blood pressure begins to fall to a basal level and in many instances, with monotonous repetition of blood pressure measurements, patients will fall asleep Ordinarily sleep is not associated with appreciable added falls of blood pressure if basal conditions in the waking state have been good

Fully normotensive persons commonly have basal blood pressures between 80/60 and 130/88, the average of a short series was 105/65 The fall of blood pressure from casual to basal is greater in hypertensive persons than it is in normotensives In a series of 20 hypertensive patients over the age of 69 the following results were obtained Casual blood pressure average 245/132, basal blood pressure average 171/95 There are, of course, many elderly people with intermediate degrees of blood pressure elevation

suggest that a renin angiotonin mechanism is seldom (if ever) the principal cause of the blood pressure elevation in this condition

(8) It seems likely that mechanisms involving structural pathology are of more importance in older than in young people For example, the effect of rigidity of the aorta and large vessels will be greater in old people, renal arteriosclerosis may be more advanced and arteriolar hypertrophy is likely to have developed further

AETIOLOGY OF HYPERTENSION IN THE ELDERLY

Essential hypertension

There are many causes for hypertension in elderly people, in fact almost all the causes which operate in young people operate sometimes in the elderly but easily the commonest cause is essential hypertension

Clinical records of elderly persons may reveal a blood pressure elevation of 20 years' duration, or alternatively that substantial hypertension has developed within a year or so

Pregnancy toxaemia

A number of elderly women give a history of what may have been a pregnancy toxaemia but it is difficult after many years to know if hypertension existed [illegible] of hypertension in relationship to pregnancy

Malignant hypertension and pyelonephritis with hypertension

Malignant hypertension is less frequent than at an earlier age, and most of the patients with nephritis of one kind or another have died, so that comparatively few are found after the age of 65 Pyelonephritis [illegible] in older people, and will often b[illegible] trating power as shown either by [illegible] after fluid restriction The blood non protein nitrogen may be elevated and sometimes there will be an excessive number of white cells in the urine

Less common causes of hypertension

Some of the less common causes of hypertension will be encountered occasionally in elderly people such as aortic coarctation, a few surviving to an old age aneurysm of a renal artery and various substantial arteriosclerotic processes may narrow a renal artery or an important branch and cause hypertension, presumably of the Goldblatt type Cases of unilateral renal disease are to be found but there is a poor prospect for the maintenance of a lasting fall of blood pressure from unilateral nephrectomy Cases of Cushing's syndrome do not seem [illegible] among [illegible]

implies, an elevation of the blood pressure. The elevation is the resultant of many components, each of which influences the complex system which determines the average level of this pressure Like streams which join to make a river, the components vary in size and importance, but all contribute something

Few of the component causes of blood pressure elevation seem to be sufficiently explained and there are likely to be important factors, the existence of which have not been recognized A few statements may be made, however, which seem consistent with present knowledge

(1) Elevations of the basal pressure are more important than elevations of the supplemental (casual-basal) pressure

(2) Some persons exhibit important blood pressure rises as a reaction to tenseness Blood pressure elevations may be expected to be greater in the following (a) Those whose vascular systems react excessively to nervous and other pressor stimuli, (b) those who are disposed to nervousness and tenseness, (c) those whose environment promotes nervousness and tenseness

(3) Obesity elevates the blood pressure in many people There is evidence that well-nourished or over-nourished communities have much more hypertension than under-nourished communities

(4) Heredity clearly influences blood pressure levels This influence is not clearly separable from the other factors which are referred to as influencing blood pressure levels

(5) It seems very probable that, when the blood pressure has been elevated for a time, hypertrophy of the heart and arterioles, by increasing contractile capacity, will lead to maintenance or further increase of the blood pressure In such ways blood pressure elevations even of a physiological kind may develop a pathological component

(6) The high blood pressure in essential hypertension is, in part at least, maintained by a change in the level at which the vasometer centre operates For example, in hypertension sympathetic vasoconstriction still occurs in response to the circulatory demands of the upright posture, and also when there is loss of blood by venesection Rises of blood pressure are still buffered by the carotid sinus and other mechanisms for example, injections of pressor drugs cause decrease in neurogenic tone The great falls of blood pressure in essential hypertension which may be obtained by large doses of hexamethonium, even when the patient is in the horizontal posture, show that the high blood pressure is in part maintained by neurogenic stimuli which reach the heart and blood vessels Removal of these neurogenic stimuli by hexamethonium leads to very much bigger falls of blood pressure in hypertension than in health

(7) It is probable that the Goldblatt mechanism is responsible sometimes for blood pressure elevations in man as in other mammals As renal ischemia occurs in essential hypertension there may be stages in the development of the disorder, or of some examples of the disorder in which a Goldblatt mechanism plays a part, but usually I believe a small one for the following reason There is evidence in man and animals that blood pressure increases induced by administering angiotonin and most other peripherally acting humoral agents are unaffected by hexamethonium The low floor blood pressures obtained after large doses of hexamethonium, which are exhibited by most patients with essential hypertension,

adverse significance of any particular casual blood pressure is increased if the corresponding basal blood pressure is relatively high and is decreased if the basal blood pressure is relatively low

Simple measures of treatment

Simple measures which may be used in asymptomatic mild hypertension are reduction of body weight when there is obesity and a sedative at night when sleep is poor Patients who are nervous or over active may be given advice about muscular and mental relaxation, but I have seen little gained by suggesting retirement There is no urgency about hypotensive therapy In our clinic the attitude to such patients is usually, ' We will see you at intervals of 6 months and be prepared to undertake treatment if that is indicated '

Rauwolfia alkaloids (reserpine, rescinnamine, recanescine and mixed alkaloid preparations)

If there is no urgency and the disorder is insufficiently severe to merit the use of ganglion blocking agents, reserpine may be tried in doses of 0 25 milligram twice daily There is, however, a serious disadvantage which will be referred to later In some instances, particularly where the blood pressure is somewhat labile, there may be a significant reduction in the blood pressure level (Vakil, 1949, Wilkins and Judson 1953, Hensler, 1953) Usually in severe hypertension the extent of the blood pressure fall is quite small when this drug is given alone (Vakil, 1949, Wilkins and Judson, 1953, Löffler and his colleagues, 1953) and may be little greater than the blood pressure falls from placebos Reserpine is mild in its effects upon the circulatory system and even in the few instances where it causes large pressure falls the patient does not usually exhibit postural hypotension and rarely experiences faintness

Reserpine

In recent years mixed alkaloidal preparations from R...

... Three pure substances exhibiting hypotensive activity have been extracted, namely reserpine, rescinnamine and recanescine The three substances exhibit activity in man in doses of 0 1–0·5 milligram twice or thrice daily ...
(Serpasil) In man and ...
to lower the blood pres...
of the sympathetic ner... his colleagues, 1955) When administered to rabbits with one denervated ear, reserpine dilates blood vessels in the innervated ear but causes no dilatation in the denervated ear (McQueen and his colleagues, 1955) Evidently part at least of the action of reserpine is upon the nervous system but there is no ...
reserpine is ...
rabbit or ...
a direct ...
innervation (McQueen and his colleagues, 1955) ... vessels or upon their peripheral ... A peripheral action of reserpine can also be demonstrated on the isolated rat diaphragm preparation After

CLINICAL MANIFESTATIONS OF HYPERTENSION IN ELDERLY PERSONS

The well-known clinical manifestations of essential hypertension will not be described in detail In so far as arteriosclerotic processes are likely to be more advanced in the elderly, there may be additional features not due to the hypertension, but often modified by its presence As in younger patients, there may be congestive heart failure, left ventricular failure, undue breathlessness on exertion not amounting to failure, and a somewhat enhanced predisposition to angina of effort, cardiac infarction and coronary insufficiency Dissecting aneurysm occurs more frequently when arteriosclerosis is complicated by hypertension than when it is not Arteriosclerotic aneurysms, usually of the abdominal aorta, are also predisposed to by hypertension as are aneurysms from syphilis

Palpitation may occur with hypertension quite apart from any psychoneurotic tendencies Electrocardiographic manifestations are sometimes striking being those usually which are indicative of left ventricular strain There may be epistaxis

In elderly persons most of these clinical manifestations occur in the same way as *in younger people and usually they are similarly relieved by reduction of blood* pressure Such relief indicates that the hypertension, or the associated vaso constriction, are likely to have been responsible There are, however, some particular points which apply to elderly people In elderly people senile changes are often important as contributory causes for congestive heart failure Hence, the relationship between hypertension and congestive heart failure or cardiac asthma tends to be somewhat less definite in old patients Sometimes moderate degrees of hypertension (say 170/90) may be sufficient to precipitate failure when the heart muscle is damaged already, and in many instances reduction even of a moderate cardiac overload, by blood pressure reduction, will assist recovery to a surprising extent

Cerebral haemorrhage, cerebral thrombosis and attacks of hypertensive encephalopathy occur in the aged as in younger people Some clinicians consider that arteriosclerotic dementia and loss of memory are more common in hypertensive elderly people than in normotensives Headache, dizziness and blackouts may be hypertensive manifestations and so also may tinnitus

TREATMENT OF HYPERTENSION IN ELDERLY PEOPLE

Mild hypertension

Definition

There is some difficulty in defining mild hypertension Master and his colleagues (1952) define as the normal range $\pm 1\ 282$ standard deviations from the mean This definition extends the limits of so called "normal" blood pressure and is practically useful because in the elderly it gives an approximate indication of the blood pressure level at which one may consider whether treatment is required The systolic level at ages 60–64 is 115–170 in the male, and 115–175 in the female, the diastolic 70–100 in the male, and 70–100 in the female Somewhat higher levels are usually reported above this age range Master states that hypertension in the 60–64 age group begins at 190/110 It will be realized, however, that the

have good control over the blood pressure without discomfort (Smirk and Chapman, 1952) Even in patients who take the veratrum well at first it is found that the margin between effective action and toxicity narrows (Doyle and Smirk, 1955) so that in the course of several months or a year an effective hypotensive action persists in only a few exceptional patients A degree of blood pressure reduction occurs with the use of veratrum alkaloids in placebo doses just as it occurs with dummy tablets of various descriptions

Hydrazinophthalazine

Hydrazinophthalazine, without doubt, causes effective blood pressure reduction but it is generally agreed that when used by itself the substance causes too many side-effects, of which the most important is headache Delayed toxic effects also occur, mostly resembling collagen disorders of the type of rheumatoid arthritis and disseminated lupus erythematosus (Taylor and his colleagues, 1952, Morrow and his colleagues, 1953) Some of these complications have cleared up well on cortisone or ACTH, but deaths have been reported Hydrazinophthalazine has been used extensively in combination with hexamethonium, both drugs by mouth (Taylor and his colleagues, 1952) When hydrazinophthalazine is used smaller doses of hexamethonium have been effective

Combination with hexamethonium—It is claimed that some of the side effects of hydrazinophthalazine are ameliorated by simultaneous administration with hexamethonium Schroeder (1952) seems to have developed a technique which makes the combination practicable though the initial side-effects can be somewhat disturbing There are wide differences of op
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Hydrogenated ergot alkaloids

Hydrogenated ergot alkaloids, when administered by mouth, may initially induce small falls of blood pressure but they lose their effect and do not rank as effective hypotensive agents

Sympathectomy and rigid salt free diets

Symp

Treatment by ganglionic blockade

Selection of patients

It is seldom desirable to undertake any elaborate hypotensive treatment in elderly patients who are free from symptoms and whose basal blood pressure is near to normal The main problem is under what conditions should ganglion

exposure to reserpine there is a somewhat reduced response of the diaphragm to direct stimulation and the response of the diaphragm to stimulation of the phrenic nerve is much reduced (McQueen and Blackman, 1955) They indicate that rescinnamine and recanescine resemble reserpine in having peripheral as well as central effects

It is sometimes stated that the hypotensive effect of reserpine in man may be explained in terms of its sedative action Certainly in many patients the effects of reserpine alone do not exceed those which may be expected from sedation, but in some patients, including a few severe cases, there are large blood pressure falls well outside the placebo range. But even when reserpine, given alone, has little effect on the blood pressure, some action has obviously taken place, for even small doses of reserpine, 0 5 milligram daily, can be relied upon to increase the depressor action of hexamethonium and of pentapyrrolidinium (Ansolysen) (Doyle and his colleagues, 1954, 1955, Freis, 1954) Furthermore, when doses of reserpine are administered which are in excess (9 milligrams daily) of those which should be used clinically, large blood pressure falls, well outside the placebo range, may be induced in a majority of patients (Doyle and Smirk, 1954) Beyond question this is a genuine hypotensive substance but when it is given alone an effect is not always demonstrable, even in large doses Rescinnamine and recanescine also enhance the hypotensive action of pentapyrrolidinium (Smirk and McQueen, 1955)

Side-effects

The only side-effect of reserpine which need occasion serious concern is unfortunately a grave one, namely, psychotic depression (Doyle and Smirk 1955) Mild degrees of mental depression are frequent This may be overlooked unless a direct enquiry is made, because it may start after months of apparently satisfactory treatment, and therefore it may not be recognized by the patient as being associated with the drug In possibly 8 per cent of patients the depression is of a serious degree and of 100 patients 4 in our clinic have had psychotic depression requiring hospital care and electrical convulsive therapy It is of note that about half of our more severe cases had had at least one episode of depression before any hypotensive treatment was undertaken In other instances there had been a bereavement or other mental strain Nevertheless, cases occur on reserpine without other provocation and not only must care be taken in selecting patients for treatment, but patients must be seen regularly when taking the drug This disadvantage of reserpine is encountered also in its combinations with ganglion-blocking agents. There is a possibility that rescinnamine may be less likely to cause depression Several patients with mild depression lost this when transferred from reserpine to rescinnamine or recanescine and have remained comfortable for periods up to 4 or 5 months (Smirk and McQueen, 1955) We have encountered some depressions on rescinnamine

Veratrum alkaloids, hydrazinophthalazine and hydrogenated ergot alkaloids

Veratrum alkaloids

Veratrum alkaloids are unsuitable for use in elderly patients The effective hypotensive dose is so close to the emetic dose that only a minority of patients

have good control over the blood pressure without discomfort (Smirk and Chapman, 1952) Even in patients who take the veratrum well at first it is found that the margin between effective action and toxicity narrows (Doyle and Smirk, 1955) so that in the course of several months or a year an effective hypotensive action persists in only a few exceptional patients A degree of blood pressure reduction occurs with the use of veratrum alkaloids in placebo doses just as it occurs with dummy tablets of various descriptions

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ex [illegible]

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by [illegible]

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Sympathectomy and rigid salt free diets

Sympathectomy and rigid salt free diets have no place in the treatment of elderly hypertensive patients as more effective alternatives are available Moderate salt restriction may be used when control of the blood pressure is insufficient by itself to relieve congestive heart failure

Treatment by ganglionic blockade

Selection of patients

It is seldom desirable to undertake any elaborate hypotensive treatment in elderly patients who are free from symptoms and whose basal blood pressure is near to normal The main problem is under what conditions should ganglion

blockade be advised for elderly hypertensive patients who exhibit clinical manifestations which are the result of the hypertension Originally we did not treat hypertensives over 60 years of age lest we did more harm than good, but more recently we have found in practice that good results with added comfort may be obtained for most elderly hypertensive patients with symptoms, even in the 80 s

Our present view is that where hypertensive manifestations are causing discomfort or distress, or are impairing activity, serious consideration should be given to effective hypotensive measures, whatever the age

In the elderly, as defined, some matters require special consideration As treatment with ganglion blockers involves co operation from the patient, preservation of normal intelligence is desirable but failing this, there must be a suitable relative or district nurse who will undertake responsibility It will not be overlooked that patients who *hold their own at a short medical interview may be distinctly* impaired Some patients, whose memory is poor, control their treatment well if doses and instructions are written down for them It is necessary to consider if the patient will be able to handle an occasional hypotensive episode with dizziness or faintness without undue risk of a fall with injury In this connexion the presence of such impairments as osteoarthritis of the hips or an old hemiplegia is relevant *Risks can be minimized by being content with smaller degrees of blood pressure* reduction Where a patient has already had an important cerebral vascular accident, the question of whether hypotensive therapy is worth while needs to be considered It seems reasonable that this should largely depend on the prospects of recovery of useful function and on the presence of any hypertensive symptoms for which there is expectation of relief

The existence of prostatic or other difficulties in emptying the urinary bladder are likely to be accentuated by treatment and occasionally this warrants cessation of treatment The problem has been overcome by obtaining surgical relief if the trouble is prostatic Elderly patients who have much constipation will have rather more difficulty with treatment than others and unless there is some urgency it is well to see what can be done with this first

A prime indication for hypotensive therapy is congestive heart failure, cardiac asthma or a substantial degree of breathlessness short of these (Smirk and Alstad, 1951, Palmer, 1952, Hayden, 1954, Morrison, 1953)

In the past we only employed effective hypotensive agents, such as pentapyrrolidinium (Ansolysen) when the blood pressure was very high, but lately we have

patients, some elderly, exceeded our expectations While the effects are not as dramatic as in patients with very high blood pressures, there was often an important relief of breathlessness, usually on the first day of administration of adequate doses, and in some patients we obtained recovery from heart failure without recourse to other measures such as digitalis It seems that it is possible to use *methonium salts to treat congestive failure even when the blood pressure is but* moderately elevated, the aim being to lessen the work of the heart

An indication at least for a trial of therapy is a substantial hypertension associated with angina of effort (Smirk and Alstad, 1951, Doyle and Kilpatrick,

... cent of substantial hypertensive
... portant relief from
... t degree, but not
excessively We have several times encountered patients whose angina was present if the blood pressure was at full hypertensive levels and also if it fell below some

...

of peritrate or trinitrin tablets or of reduction in the metabolic rate by methyl thiouracil may be employed concurrently It will usually be arranged that the nitrites are administered when the blood pressure is rising between doses of the hypotensive agents employed

When there are encephalopathic attacks, such as temporary losses of consciousness blackouts or episodes of unilateral weakness or of tingling in limbs, the effective administration of methonium salts has almost always been useful in diminishing or abolishing the attacks

Our impression has been that relief from hypertensive manifestations occurs almost as frequently in elderly as in comparatively young patients, but elderly people have more symptoms due to other causes and it is not to be expected that such other symptoms will be much affected

Of the patients who are accepted for treatment, relief of potentially reversible hypertensive manifestations should be obtained in the great majority, and failure in any appreciable proportion to obtain such results without undue discomfort or distress from side-effects should be attributed to the inadequacies in the technique of hypotensive therapy used—in other words to the physician—and not to peculiarities in the response of the patients

...

... pyrrolidinium (pentolinium, Ansolysen), but in general hexamethonium salts have been superseded, for by mouth they are comparatively ineffective once full toleration has developed In the majority of elderly persons good control over blood pressure levels can be obtained with smaller doses than are needed in younger people and adequate control over the blood pressure level is usually obtained by oral therapy with Ansolysen or by a combination of a Rauwolfia alkaloid with Ansolysen The reader is therefore referred to other publications (Smirk, 1953, Smirk, 1954b) for details of treatment by injection

Dosage—Ansolysen is supplied by the makers in a tablet of 40 milligrams scored for subdivision into half tablets of 20 milligrams and in a 200-milligram tablet In many patients for ...
accuracy of 10 milligr ...
particularly to elderly ...

The initial oral dose ...
If initial doses of 20 m...
though not dangerou... ...sequent regulation of the dose

should be in terms of blood pressures measured with patients in the sitting and standing postures Where it is practicable the blood pressure should be measured by technicians or by trained nurses, preferably the former, at half-hour intervals throughout the day Ordinarily the aim is to adjust the dose so as to bring the blood pressure down to a normal level (120/85) in the standing posture Often in elderly people one must be content with reduction to 140/95 or to 130/90 If the blood pressure is only taken with the patient lying or sitting then the fall of blood pressure may apppear to be quite modest but, when the patient stands, postural hypotension may cause faintness The blood pressure in the standing posture indicates whether, on a given dose, the patient is likely to have hypotensive symptoms Accuracy of dosage is of paramount importance in the treatment of hypertensive patients and 200 milligram tablets should never be subdivided as this leads to inaccuracy in dosage If a 100 milligram dose is required, it should be given as 2½ small tablets of 40 milligrams

There is far too little realization of the fact that great accuracy is required in dosage if one is to steer the patient between the disadvantages of inadequate falls of blood pressure and excessive side-effects Control of dosage in terms of the standing blood pressure makes the regulation of the blood pressure level by methonium salts a very safe procedure, because a dose which would cause the patient to faint when standing is nevertheless perfectly safe when the patient lies down, in so far as the blood pressure rises promptly in the horizontal posture The reverse situation is encountered when patients are put flat in bed in hospital and the dose scaled up until an appreciable blood pressure fall is obtained, then the amount of drug used may be quite excessive and on rising from bed the patient may faint Furthermore, the dose required to induce an adequate blood pressure fall with the patient flat in bed incurs an important risk of ileus, and of excessive discomforts from other side effects

To maintain adequate blood pressure falls without the use of dangerous doses, the patient should maintain the sitting or standing posture, not only during the day, but should be propped up in bed with a back rest at 45° at night The horizontal posture should be used only to combat occasional episodes of hypotension Mostly patients sleep propped up but if they have real difficulty then they may sleep flat in bed with the head end of the bed raised 1 foot 4 inches above the ground level Six-inch blocks are inadequate In many clinics, even in teaching hospitals, patients are not instructed about this control of posture and may even be told to lie down flat after taking the drug To the best of my knowledge the only purpose of methonium administration is to lower the blood pressure To combine the administration of methonium with instructions which prevent an adequate fall of blood pressure during an important part of the day is illogical and a source of much trouble with side effects and of failure to relieve hypotensive manifestations

It is now well known that with continued administration drug toleration develops so that the dose of pentapyrrolidinium may have to be raised, at first daily or every other day and later at longer intervals In middle aged or younger patients the increment by which the dose is raised is 20 milligrams on each occasion but in elderly persons, until their responses are known, the increment should be 10 milligrams In the course of 2 or 3 months the dose may rise considerably but

rarely to the very high levels (1800 milligrams per day) occasionally encountered in middle aged or younger people Usually within 2 or 3 months the dose becomes comparatively stable

In general, the best effects are obtained by the maximum degree of blood pressure lowering which is well tolerated but in a few elderly people the difficulties of management are such that it may be justifiable to give the least dose of pentapyrrolidinium which is found by trial to relieve symptoms

Side-effects—The occurrence of hypotensive episodes is a problem in dosage adjustment which has been referred to already Side-effects such as dry mouth, blurred vision and constipation may be greatly lessened by combining ganglionic blockade with the use of reserpine The dose of the methonium compound is thereby much reduced and parasympathetic side-effects decreased Pilocarpine, [illegible]

[illegible] by injection weekly at first and later fortnightly

There are problems which arise occasionally in the early stages of obtaining control over blood pressure levels which may call for a decision as to whether treatment should be discontinued or modified In some middle aged or elderly persons, when the blood pressure falls to normal or below, there may be hemiparesis or tingling or numbness in a limb In other patients coronary pain occurs when the blood pressure is low We were much alarmed initially at such events but it has been [illegible]

neurological manifestations pass off in a few hours and the coronary pain disappears within a short time We regard such symptoms as an indication to reduce the dose given but unless they occur frequently we have not usually needed to discontinue treatment A further trouble is that some elderly patients become confused [illegible] od pressure is low Our experience [illegible] ually these manifestations may not [illegible] extent of the blood pressure fall where such manifestations persist, continued treatment is inappropriate

Assessment of the efficiency of control over blood pressure levels

The comfort of hypertensive patients and the efficacy of control over their blood pressure levels depend upon the method used to ascertain whether the blood pressure fall is adequate or not There is ample evidence that casual blood pressures taken at an out patient clinic or doctor's office are inadequate as a basis for control of hypertensive therapy (Ayman, 1934, Alam and Smirk 1943) Indeed it is almost certain that [illegible] unsatisfactory [illegible] later for the c[illegible] [illegible] re are two methods of control which can be employed, the ideal being a combination of the two (a) Control in terms of hypotensive symptoms, and (b) control in terms of half or whole day observations on the course of the blood pressure

should be in terms of blood pressures measured with patients in the sitting and standing postures Where it is practicable the blood pressure should be measured by technicians or by trained nurses, preferably the former, at half-hour intervals throughout the day. Ordinarily the aim is to adjust the dose so as to bring the blood pressure down to a normal level (120/85) in the standing posture Often in elderly people one must be content with reduction to 140/95 or to 130/90 If the blood pressure is only taken with the patient lying or sitting then the fall of blood pressure may apppear to be quite modest but, when the patient stands, postural hypotension may cause faintness The blood pressure in the standing posture indicates whether, on a given dose, *the patient is likely to have hypotensive* symptoms Accuracy of dosage is of paramount importance in the treatment of hypertensive patients and 200-milligram tablets should never be subdivided as this leads to inaccuracy in dosage If a 100-milligram dose is required, it should *be given as 2½ small tablets of 40 milligrams*

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Briefing of patients

A matter which often goes unrecognized is the need for careful briefing of patients In practice they must have a knowledge of procedure at least equivalent to that which the diabetic has It is futile to expect even intelligent patients to obtain a good regime without instruction and at the outset close supervision Adequate co-operation from patients is difficult to secure without a set of cyclostyled or printed instructions

The combination of pentapyrrolidinium (Ansolysen) with reserpine (Serpasil)

Hypertensive patients who are given a fixed dose of reserpine (0 25 milligrams twice daily) are much more readily controlled and by much smaller doses of ganglion blocking agents such as pentapyrrolidinium (Freis 1954 Doyle and his colleagues 1954 Smirk and his colleagues 1954) Patients on this combination escape or lessen many of the troublesome side-effects of ganglionic blockade such as dry mouth blurred vision and constipation Furthermore when this combination is used the casual blood pressures though an imperfect guide to the effects of the dr [illegible]

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reserp [illegible] pentapyrrolidinium than on pentapyrrolidinium alone It is unfortunate that reserpine leads in some patients to degrees of mental depression which are always important to the patient and sometimes are a source of anxiety to both patient and doctor The advantages of the combination have therefore to be relinquished in some patients As an alternative to reserpine we have employed rescinnamine in the same dose In over 50 per cent of patients mild to moderate degrees of depression which occurred on reserpine have dispersed without loss of hypotensive efficiency on transfer to rescinnamine In the other patients rescinnamine seems to be *less well tolerated* than reserpine even when depression is relieved There seems to be an important use for both of these [illegible]

comb

[illegible] Recanescine in a dose of 0 75 milligrams daily may have an advantage over reserpine and rescinnamine

RESULTS OF HYPOTENSIVE THERAPY

Effective hypotensive therapy relieves hypertensive symptoms [illegible] objective improvement (D

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In our clinic, which subserves routine and research requirements, our hypertensives attend daily for three weeks and their blood pressures are measured throughout the day at half-hour intervals in the sitting and the standing postures Mostly they attend as out-patients In the absence of research interests the number of attendances could be reduced Doses are adjusted in terms of these results The only blood pressure which matters from the standpoint of dosage adjustment is the blood pressure in the standing posture at the trough of the blood pressure fall, and the aim is to reduce this trough blood pressure to a fully normal level (120/80) or as near to that level as is expedient Small degrees of blood pressure reduction are rarely sufficient to produce adequate benefit in people with important hypertensive manifestations, but in elderly persons more compromise is permissible than in younger people, and it may be necessary to limit the fall in the trough blood pressure (standing) to say 135/90, even occasionally to 140/95 Where a special hypertensive clinic with technicians, or a technical sister, is not available, consideration of the patient's symptoms will give a very much better idea of whether the dose is inadequate or excessive than casual blood pressure readings, even if they are taken at a time judged to be at the trough of the blood pressure fall. Control over dosage by symptoms is used routinely at our out-patient department after the patient has been discharged from ward or control clinic Some patients may then go for a month or a year without a further all-day test

Control of dosage by hypertensive symptoms

The technique of adjusting dose in terms of hypotensive symptoms has been checked against all-day tests and is conducted as follows The patient is asked to increase the doses of the drug by small increments—say 20 milligrams for younger patients and by increments of, say 10 milligrams initially and later 20 milligrams for elderly patients—until such time as they feel a little faintness when standing quietly, or alternatively, they are observed by their friends to be unusually pale when so standing or they feel weak and floppy and have an urgent need to sit or lie down Such symptoms as these are readily recognized by one acquainted with them as hypotensive and they are an indication for the patient to reduce the drug dose by one increment at a time (20 milligrams or, for some elderly patients, 10 milligrams), until such time as these symptoms are just relieved. The symptom of faintness occurs at the period of maximum drug action, often about 2½ hours after an oral dose taken half an hour before a meal

We find in actual practice, by direct test, that patients who have adjusted their dose in this way are usually getting an adequate but not an excessive fall of blood pressure We still use all-day tests as an additional measure, and as a check on control by symptoms Control of dosage in terms of hypotensive symptoms is very much superior to adjustment in terms of out-patient casual blood pressures In private practice several doctors in New Zealand have adopted this plan of control by symptoms, but they also arrange a morning when their nurse or receptionist measures blood pressures for a half-day on a group of patients called up for the purpose The degree of control which may be achieved in private practice in this way is quite good Freis (1954) has used home blood pressures taken by the patient who has been instructed in the use of a sphygmomanometer We have used this in exceptional instances but prefer control by symptoms

Briefing of patients

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escape or lessen many of the troublesome side effects of ganglionic blockade such as dry mouth blurred vision and constipation Furthermore, when this combination is used the casual blood pressures though an imperfect guide to the effects of the drugs are nevertheless not so misleading as they are when only a ganglion blocking agent is used The casual blood pressure readings at our out patient s clinic have been consistently lower with patients on the combination of reserpine and pentapyrrolidinium than on pentapyrrolidinium alone It is unfortunate that reserpine leads in some patients to degrees of mental depression which are always important to the patient and sometimes are a source of anxiety to both patient and doctor The advantages of the combination have therefore to be relinquished in some patients As an alterna[illegible]

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[illegible] [illegible]serpine and rescinnamine

RESULTS OF HYPOTENSIVE THERAPY

Effective hypotensive therapy relieves hypertensive symptoms [illegible] objective improvem[illegible]

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cent great improvement in such changes are, we think, to be regarded as indications of an inadequate régime Headaches and dizzy attacks should be relieved and attacks of encephalopathy should be much reduced in frequency Heart failure and cardiac asthma should be relieved in many instances, even in elderly persons, without the use of other measures such as digitalis, mercurial diuretics and salt-free diet, and in almost all cases heart failure should be relieved when these measures are employed additionally In a good proportion of patients, say 50–75 per cent, angina of effort, occurring in substantially hypertensive persons, should be alleviated to an important degree provided an appropriate blood pressure reduction has been achieved Over a period of 6 years experience with ganglion blocking agents involving over 400 patients I have become increasingly confident of a statement made some years ago, namely that failure to bring an important degree of relief in the big majority of patients is either due to imperfect selection of patients or, much more frequently, to insufficient attention to the necessary details of effective hypotensive therapy.

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CHAPTER 6

GLYCOSURIA AND ITS SIGNIFICANCE

K. O. Black and C. F. Cooper

A MINUTE quantity of reducing substances can be detected in normal urine by special methods but the presence of glucose demonstrable by the ordinary clinical tests is an abnormal finding which, although sometimes unimportant, always demands investigation. The blood sugar of a healthy person does not rise much above 160 milligrams per 100 millilitres after meals and rarely exceeds 180 milligrams per 100 millilitres which is assumed to be the normal renal threshold. Sugar is excreted either because the level of blood sugar has risen above the normal renal threshold or because, as in renal glycosuria, the threshold itself is below the normal With the single exception of renal glycosuria, the presence of glucose in the urine is always an indication that the blood sugar is higher than normal Hyperglycaemic glycosuria is usually classified into three groups. Occasionally transitory glycosuria after meals is found to be associated with a glucose tolerance curve of the type which Maclean (1924) called the lag curve The curve rises steeply after glucose to above the renal threshold and then falls rapidly to normal This comparatively rare and benign condition sometimes follows operations on the stomach Most commonly when glycosuria is found to be associated with hyperglycaemia, diabetes mellitus is the cause It differs from glycosuria of the lag curve type in that hyperglycaemia is not transitory but prolonged for at least some hours after each carbohydrate meal. Finally, hyperglycaemia with glycosuria may occur as a temporary abnormality secondary to such disturbances as infections, initial feeding after starvation, prolonged inactivity or as a reversible disorder of carbohydrate metabolism related to endocrine disorders and obesity These conditions present a glucose tolerance curve similar to that of mild diabetes, but they are to be distinguished by the fact that they are temporary and usually clear up on removal of a known cause, whereas diabetes persists unless and until it is modified by insulin treatment and dietary measures

Fifty years ago a patient with severe diabetes had little chance of survival into old age Diabetic ketosis and acute infective complications are now rarely fatal and, as life has been prolonged, atheroma and chronic degenerative changes in the eyes, kidneys and nervous system have become the major causes of disability and death The progress of these degenerative changes is hastened by neglect of the diabetes, hence early diagnosis is of the utmost importance

INCIDENCE

Examination of recruits for the armed forces gave some idea of the incidence of glycosuria among men of military age. Lyall (1946) reported 387 British recruits found to have glycosuria out of a total of 40,000, an incidence of 0·97 per cent.

A similar incidence of glycosuria (1 14 per cent) was found in 51,000 American college students on whom routine urine tests had been carried out (Watson, 1939) Other studies in America have shown a rather higher incidence of 2 per cent or more among young adults That glycosuria occurs with still greater frequency in the population as a whole has been revealed by the recent large scale surveys sponsored by the American Diabetes Association for the purpose of detecting undiagnosed cases of diabetes These indicate that the incidence of glycosuria in the general population may be as high as 3 5 to 4 per cent (Marble, 1952)

Relative frequency of various kinds of glycosuria

Reliable data have been obtained from some of these studies concerning the relative frequency with which the various kinds of glycosuria occur The main varieties for consideration are (1) diabetes mellitus, (2) renal glycosuria, (3) lag glycosuria, (4) anomalous cases with doubtful tolerance curves, and (5) a miscel-

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examined As might be expected, figures based on the examination of recruits show a relatively small proportion of diabetic to non-diabetic glycosurias A second source of discrepancies between the results of different authors arises from

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[illegible] investigation The presence of glycosuria was confirmed in 782 recruits aged 18 to 45 years Of these, 65 per cent had renal glycosuria, 13 8 per cent were found to have sugar tolerance curves of the lag storage type, 18 per cent had diabetes mellitus [illegible]
387 recrui[illegible]
unclassifie[illegible]
showing t[illegible] accounts for the large majority of non-diabetic glycosurias The large American surveys have shown that roughly half of the cases of glycosuria discovered in a large population are due to diabetes

PROGNOSIS OF NON DIABETIC GLYCOSURIA

It is of some importance for clinical and life assurance purposes to know what is the ultimate fate of patients having renal glycosuria or lag curves, and whether they are likely to develop diabetes in later years Graham (1950) reviewed this subject in his Harben Lectures and reported a personal series of 81 cases of non-diabetic glycosuria collected [illegible]
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fo[illegible] glycosuria, remained well [illegible] then developed thirst and polyuria and was found to have a

glucose tolerance curve typical of diabetes At the Mayo Clinic the incidence of diabetes in 170 patients with renal glycosuria was not greater than the expectation for the development of diabetes in the population as a whole (Wade, 1936) It may be concluded that the presence of renal glycosuria does not predispose to diabetes and the same probably applies to lag curves provided that the criteria for diagnosis are strictly applied

The outlook is much less favourable when glycosuria is associated with abnormalities of glucose tolerance other than those typical of the lag curve, prolongation of the tolerance curve being more significant than height in determining the liability to develop diabetes Many authors have reported on the frequency with which diabetes develops among patients whose glucose tolerance curves were originally classified as suspicious though not frankly diabetic Rabinowitch (1949) followed up for 10 years 133 patients whose urine had once been found to contain sugar and whose glucose tolerance curves were regarded as doubtful, having a peak which was either abnormally high or abnormally late Nearly 30 per cent of these patients developed frank diabetes The importance of the early diagnosis and treatment of the borderline case of diabetes was well illustrated in this series 84 of the original group were treated by restricted diets and the remaining 49 were not on diets The incidence of diabetes was twice as high in the untreated group

DIAGNOSIS

Tests for detection of sugar

The tests in most general use for the detection of sugar in the urine depend on the reduction of an organic copper salt in alkaline solution to cuprous oxide Benedict's test is performed by adding 0 5 millilitre or eight drops of urine to 5 millilitres of the reagent in a test-tube and boiling for two minutes over a flame or placing in a water bath or pan of boiling water for five minutes A slight colour change to green is significant if a yellow precipitate forms on standing but white or greyish precipitates due to phosphates or a change of colour without any precipitate may be ignored Benedict's test is preferable to Fehling's test which is less sensitive in detecting small amounts of sugar and more apt to give false positives with the normal urinary constituents Solvellae cupri diagnosticae (clinitest) are tablets containing the reagents in solid form They are easy to carry and they are convenient to use because no external source of heat is required The test is done by putting 5 drops of urine and 10 drops of water into a test-tube and adding one of the tablets Sufficient heat is generated by chemical reaction to boil the solution

If a reducing substance is found in the urine, several possibilities have to be considered The reduction is most often due to the presence of glucose but occasionally some other sugar or a non-carbohydrate reducing substance is responsible Homogentisic acid, present in the urine of alkaptonurics, reduces alkaline copper solutions with a characteristic darkening of the solution In highly concentrated urines slight reduction of the copper solution may occur due to the presence of uric acid and creatinine Reduction may also follow the taking of certain drugs, such as salicylates, aspirin and *para* aminosalicylic acid If the reduction persists when all drugs have been stopped and the fluid intake is adequate, a reducing sugar may be presumed to be present Although logically the next step might seem

to be identification of the sugar concerned, glucose is so much the most likely because it is the commonest of the sugars to appear in the urine, and diabetes is so much the most important cause of glycosuria, that in practice the immediate question is whether diabetes is present or not If symptoms of diabetes are present

glycosuria associated with the lag curve If the glucose tolerance curve is normal yet the urine contains sugar, the condition may be renal glycosuria or the urine may contain some sugar other than glucose At this stage the sugar present in the urine should be identified in the laboratory The preparation of osazones and fermentation tests are reliable in experienced hands, and the development of paper chromatography has greatly facilitated the identification of small quantities of sugars in urine

Blood sugar

The presence of hyperglycaemia may be established by determination of the blood sugar after an overnight fast or preferably following a meal containing carbohydrate The fasting blood sugar is usually raised in severe diabetes but is often quite normal in milder forms of the disease It is normally 80–120 milligrams per 100 millilitres and values of 130 milligrams per 100 millilitres or higher are commonly taken to indicate diabetes
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Glucose tolerance test

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Samples of blood and urine are collected

glucose tolerance curve typical of diabetes At the Mayo Clinic the incidence of diabetes in 170 patients with renal glycosuria was not greater than the expectation for the development of diabetes in the population as a whole (Wade, 1936) It may be concluded that the presence of renal glycosuria does not predispose to diabetes and the same probably applies to lag curves provided that the criteria for diagnosis are strictly applied

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Renal threshold

The renal threshold varies from one person to another but is usually about 180 milligrams per 100 millilitres (capillary blood). The blood sugar does not normally exceed that level and consequently glycosuria does not occur. If the renal threshold is 140 milligrams per 100 millilitres it will be exceeded when the blood sugar rises after meals to 160 milligrams per 100 millilitres or thereabouts allowing glucose to escape into the urine A threshold as low as 70 milligrams per 100 millilitres, will allow constant glycosuria

Advances in the understanding of renal physiology have inevitably changed the concept of a fixed threshold or boundary which the rising blood sugar must

re-absorbed from the tubules into the blood The absence of sugar from normal urine depends on the capacity of the tubules to absorb all the glucose which reaches them in the glomerular filtrate Glycosuria occurs when the quantity of glucose reaching the tubules by glomerular filtration exceeds the capacity for renal tubular re absorption The quantity of glucose reaching the tubules depends on the concentration of glucose in the plasma or filtrate and on the rate of glomerular filtration Thus the appearance of glucose in the urine depends not simply on the blood sugar level but also on the rates of glomerular filtration *and tubular re-absorption* The last two factors remain so constant in normal people in ordinary

though at high concentrations the capacity of the tubules to re absorb glucose may be normal or greater than *normal* (Friedman and his colleagues, 1942)

after an overnight fast, contain sugar By this standard renal glycosuria becomes a comparative rarity, occurring in only about 84 out of a total of 40,000 cases of melituria (Marble, 1952)

Incidence

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diabetic women The co-existence of diabetes mellitus and a low threshold makes control of the diabetes difficult because urine may contain sugar

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diabetes and in

in the fasting state and the patient then drinks 50 grammes of glucose dissolved in 250 millilitres of water. Thereafter, blood and urine specimens are collected every half hour for two hours, the urine being tested for sugar and the blood sugar estimated and plotted as a curve In America the test is usually done with 100 grammes of glucose Some physicians prefer to adjust the dose to the patient's weight, giving one gramme of glucose per kilogram of body-weight

Features of the blood sugar curve

The features of the normal curve are (1) The fasting blood sugar is 80-120 milligrams per 100 millilitres, (2) the highest point on the curve does not exceed 180 milligrams per 100 millilitres, (3) the highest point of the curve occurs within the first hour, and (4) the blood sugar returns to the fasting level within two hours Glycosuria is absent throughout the test If venous blood is used instead of capillary blood, the highest point is rather lower, that is 150 to 160 milligrams per 100 millilitres The blood sugar as estimated in capillary blood obtained from a finger prick corresponds with that of the arterial blood In the fasting state this is similar to the venous level, but after meals or after the ingestion of glucose in the tolerance test the arterial level is substantially higher because the tissues take up glucose The arterio-venous difference averages 30 milligrams per 100 millilitres Capillary blood should always be used for determining the renal threshold, which is related to the concentration of glucose in the arterial blood reaching the glomeruli The use of capillary blood is also necessary for identification of the lag curve If venous blood is used, the short hyperglycaemic phase is easily missed, and the resulting glycosuria is then wrongly attributed to lowering of the renal threshold

Blood sugar curve in elderly people—Numerous studies of glucose tolerance in apparently healthy people have shown that high curves are not uncommon in old age, the proportion of abnormal curves increasing with advancing years The blood sugar may rise to 200 milligrams per 100 millilitres or rather more and show some delay in the return to normal Glycosuria is not proportionately increased because the renal threshold is commonly also raised It has been suggested that the decrease of sugar tolerance may be explained partly by decreased physical activity and intercurrent disease In a recent study (Schneeberg and Finestone, 1952) an intravenous glucose tolerance test was used to eliminate variations from irregularity of intestinal absorption The mean blood sugar in volunteers aged 40-90 years rose higher and returned more slowly to normal than in a control group of volunteers under 40 years of age Care was taken to ensure that the older people were free from pathological conditions that might adversely affect carbohydrate metabolism

RENAL GLYCOSURIA

Renal glycosuria is a harmless anomaly which is not related to any general disturbance of carbohydrate metabolism but to defective retention of glucose by the kidneys Orthoglycaemic glycosuria is an accurate synonym but such terms as "diabetes innocens" and "renal diabetes" have not found general favour because they erroneously suggest a relationship with diabetes mellitus

LAG CURVE AND POST GASTRECTOMY SYNDROME

Lag curve

Some patients with glycosuria after meals are found to have a glucose tolerance curve of the type which was originally called the lag curve (Maclean, 1924), it is also known as oxyhyperglycaemia or the steeple curve The blood sugar rises after glucose to about 250 milligrams per 100 millilitres at thirty minutes, is already beginning to fall at one hour and returns to the normal fasting level within two

for a time glucose storage failed to keep pace with glucose absorption In Lawrence's view the patient has an abnormally rapid intestinal absorption and no defect in carbohydrate metabolism (Lawrence, 1936) Though much less common than renal glycosuria lag curves are not rare and account for about 10 per cent of glycosurias If venous blood is used for the blood sugar determinations instead of capillary blood the arterial hyperglycaemia is missed and the accompanying glycosuria will be mistaken for renal glycosuria For this reason lag curves are not recognized by some American authorities It is unfortunate that the term lag curve has sometimes come to be applied to curves which show delay in returning to the normal fasting level In Maclean's cases the blood sugar reached its highest point half an hour after the ingestion of glucose, had begun to fall at one hour and reached the normal fasting level within 1½ or 2 hours It is to curves of this type that the term lag curve is properly applied

The condition is in itself symptomless and its only clinical manifestation is glycosuria after meals In Graham's view the condition is as innocent as renal glycosuria and none of his cases observed over a period of 18 years or more developed diabetes Wilder (1940) considers that the prognos

has not been reached but it seems that, provided the diagnosis of lag glycosuria is restricted to patients having sugar curves which conform to the criteria of Maclean, there is little risk that diabetes will develop later

Post-gastrectomy syndrome

The occurrence of post prandial attacks of palpitation and weakness after gastric operations led to the discovery that glucose tolerance curves of the lag type follow gastrectomy and gastro-enterostomy

kinds (1) Early or occurring within half an hour of meals, believed to be due to rapid filling of the jejunum, and (2) late attacks occurring from one and a half to three hours after meals due to hypoglycaemia

The initial hyperglycaemic phase is ascribed to rapid jejunal filling and similar curves can be produced in normal people by introducing glucose directly into the

per 100 millilitres The maximal rate of renal tubular absorption of glucose decreases progressively with age There is a corresponding decrease of glomerular filtration rate and other functions of the kidney, suggesting loss of functioning nephrons rather than a specific defect (Miller and his colleagues, 1952)

Renal glycosuria with other syndromes

Failure of the renal tubules to absorb glucose may be associated with other defects of tubular function In addition to glucose, the tubules are concerned with re-absorption from the glomerular filtrate of phosphate, bicarbonate, potassium, ammonia and amino-acids Defective tubular absorption of these ions leads in the Fanconi syndrome to a combination of renal glycosuria with excessive loss of calcium, phosphate, amino-acids and other urinary constituents Systemic depletion leads to acidosis and rickets or osteomalacia Such syndromes nearly always have their clinical onset in early childhood, but may persist into adult life

Clinical findings

Renal glycosuria is symptomless and the only clinical finding is the presence of sugar in the urine Individual specimens of urine may contain 2 per cent or more of sugar but the total daily loss of glucose is not great, amounting usually to 5-15 grammes though as much as 30 grammes or more may be lost if the threshold is very low If the threshold is only slightly lowered sugar is not present in the urine passed before meals and only appears in the first and perhaps second hours after the ingestion of carbohydrate If the threshold is very low, below the fasting blood sugar level, sugar is present in all specimens of urine throughout the day, although the quantity excreted is greater after meals

Distinguishing renal glycosuria from melituria

Renal glycosuria is harmless and its chief clinical significance is that it may be mistaken for diabetes mellitus The error is unfortunate because dietary restriction is unnecessary and insulin administration is dangerous and likely to cause hypoglycaemia When it has been established that the glucose tolerance test is normal and that glycosuria occurs at normal blood sugar levels, the presence of glucose must be confirmed in the laboratory in order to distinguish renal glycosuria from pentosuria and other rare forms of melituria If all specimens of urine contain the same amount of reducing substance, in spite of considerable differences of the meals in carbohydrate content, the probability is that a reducing sugar other than glucose is present

Dietary restriction

Some dietary restriction is advisable in cases of glycosuria of which the cause cannot be determined immediately but once the diagnosis of renal glycosuria has finally been established no treatment is required The diet should not be restricted and any attempt to control glycosuria by the use of insulin is absolutely contra-indicated.

Thyrotoxicosis and diabetes

The causal relation between thyrotoxicosis and diabetes is uncertain. The influence of the thyroid hormone on carbohydrate metabolism is proportional to the increase of *metabolic rate* which it produces and is confined to increased ... from the intestine and increased

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only occurs in thyrotoxicosis if the pancreas is unable to respond to the increased demand for insulin arising from persistent elevation of the metabolic rate

Anterior pituitary

The hormones of the anterior lobe of the pituitary known to influence carbohydrate metabolism are the growth hormone and adrenocorticotrophic hormone (ACTH). ACTH exerts its effect by increasing the secretion of adrenal cortical steroids. Purified growth hormone has been shown to produce permanent diabetes when administered to dogs and cats. It is not surprising, therefore, that in man the pathological excess of growth hormone secreted in cases of eosinophil adenoma ...

clinical nature, but exhibits variations in intensity corresponding with the waxing and waning of pituitary activity characteristic of the disease. If the disease is arrested by treatment or runs its course and becomes burnt out, as happens quite commonly, the diabetes may be permanently cured

Adrenal cortex

ACTH stimulates the adrenal cortex to secrete gluco corticoids, which accelerate the formation in the liver of glycogen from non-carbohydrate sources and raise

about half of the patients, some of whom show the features characteristic of diabetes. Diabetes also occurs in the adrenogenital syndrome as the "diabetes of bearded women." The term *steroid diabetes* has been applied to a diabetic state arising from excess of adrenal steroids whether therapeutically administered or derived from ...

... associated with a functioning tumour of the adrenal cortex has been cured by removal of the tumour

Adrenal medulla

Injection of adrenaline raises the blood sugar and may cause temporary glycosuria. It has been known for many years that the secretion of adrenaline in response

small intestine through a duodenal tube. Smith and his colleagues (1953) found that the patients who had dumping attacks, hence most rapid emptying of the gastric remnant, showed the steepest rise of blood sugar though even the symptomless patients had hyperglycaemia of the lag type

ENDOCRINE CONTROL OF BLOOD SUGAR

Metabolic processes

The blood sugar level is governed by the relative rates at which glucose enters and leaves the blood There are two main sources from which glucose enters the blood, namely the small intestine and the liver The liver not only converts glucose to glycogen, which serves as a store from which glucose can be released as required, but is also capable of forming glucose from non-carbohydrate sources (gluconeogenesis) From the blood, glucose is taken up by the tissues (utilization) In the tissues it is utilized in three ways, some being oxidized to supply energy requirements, some being converted to glycogen in the liver and muscles, and some being transformed into fat and stored in the fat depots

Action of hormones

The hormones regulate the blood sugar by influencing these metabolic processes Insulin accelerates the utilization of glucose by the tissues, thereby lowering the blood sugar level A number of hormones raise the blood sugar but insulin is the only one that can lower it The blood sugar is prevented from falling dangerously low in starvation by hormones of the anterior pituitary and adrenal cortex, the effect of which is to accelerate the formation of glucose from protein in the liver and to decrease utilization by the tissues Adrenaline tides over the immediate crisis of hypoglycaemia by promoting the release of glucose from the liver glycogen but has no direct effect on gluconeogenesis or peripheral utilization The thyroid hormone does not take part in the physiological regulation of the blood sugar but when present in excess, as in hyperthyroidism, disturbs the normal regulatory mechanism and causes hyperglycaemia

Hyperthyroidism

Glycosuria and abnormal glucose tolerance curves are common in hyperthyroidism Glycosuria was found to occur in 38 6 per cent of patients with primary hyperthyroidism (Root, 1952) The glucose tolerance curve may show a fasting value at the higher limit of normal, it rises to an abnormally high peak half an hour after the ingestion of glucose, returning to the normal fasting level within two hours The milder disturbances of carbohydrate metabolism are restored to normal when the thyrotoxic state has been corrected by medical or surgical measures True diabetes is comparatively rare, being found in only about 3 per cent of all cases of hyperthyroidism (Wilder, 1940) Excess of thyroid hormone makes pre-existing diabetes worse and more difficult to treat while successful treatment of the thyroid condition renders the blood sugar more stable and leads to a fall in the insulin requirement but does not abolish the diabetes

364 milligrams and failing in 47 of the patients to return to the fasting level within three hours Slight to heavy glycosuria was a common but not invariable finding Similar but less extreme abnormalities of the glucose tolerance curve were observed in inactive children, some of whom had glycosuria after the ingestion of glucose It seems probable that the glycosuria, hyperglycaemia and impaired glucose tolerance which have been described in patients with arthritis, cancer and other chronic diseases may be explained at least in part by the inactivity caused by the disease rather than by the specific effect of the disease itself

Intracranial lesions

The relationship of intracranial lesions to carbohydrate metabolism has attracted attention since Claude Bernard produced glycosuria in dogs by needle puncture of the floor of the fourth ventricle In man, glycosuria is not uncommon after head injuries, especially those involving concussion or fracture of the skull and may also accompany subarachnoid and other intracranial haemorrhage, raised intracranial pressure and intracranial lesions of various other kinds The excretion of glucose is associated with hyperglycaemia and an abnormally high and prolonged glucose tolerance curve The disturbance is temporary lasting for a variable time but ultimately clearing up in convalescence Temporary glycosuria and a disturbance of sugar tolerance of the same kind occurs with about the same frequency after fractures and injuries of parts of the body other than the head (Thomsen, 1938) These transient disturbances are quite distinct from diabetes (Joslin, 1940)

Glycosuria in infections

Infections have an adverse effect on sugar tolerance in both diabetic and non-diabetic subjects They increase the severity of established diabetes and may cause temporary glycosuria in patients who show no signs of diabetes before or after the infection Williams and Dick (1932) found glycosuria in 41 per cent of 108 non diabetic patients with scarlet fever, pneumonia and various other infectious illnesses The glycosuria is associated with hyperglycaemia and a glucose tolerance curve which is abnormally high and prolonged or of frankly diabetic type The disturbance is usually mild and transient [illegible]

[illegible] after the infection has subsided [illegible] caution is required in the presence of any mild or chronic infection in an ambulant patient and it is unwise to come to a final conclusion on the strength of an abnormal glucose tolerance curve until clinical evidence of infection has subsided and the temperature and erythrocyte sedimentation rate are normal

Alimentary glycosuria

The term alimentary glycosuria was formerly used in the belief that the absorption of a large quantity of sugar could cause glycosuria in a healthy person

to emotional stimuli can provoke glycosuria Anxiety may explain the high fasting blood sugar and glycosuria sometimes found at the first medical examination of a patient whose carbohydrate metabolism is subsequently found to be normal

GLYCOSURIA AND VARIOUS PATHOLOGICAL STATES

Glycosuria is found in association with a great number of pathological conditions In addition to those mentioned below, it has been observed in numerous acute and chronic diseases and after anaesthetics The glycosuric effect of these conditions may be due to the physical inactivity which they entail In infections, the disturbance of blood sugar regulation may be explained by increased metabolism whilst in other diseases such as acute coronary occlusion, it has been attributed to increased adrenal cortical activity The cause of the disturbance of sugar tolerance which occurs in malignant disease is obscure

Glucose tolerance is impaired by starvation or by a low intake of carbohydrate A patient who has been kept on a restricted diet before having a glucose tolerance test may have an abnormal curve suggesting diabetes Sugar and ketone bodies may be present in the urine The effect of semi-starvation has been observed in released prisoners-of-war who had glycosuria at first when normal feeding was resumed

Obesity

Over-feeding increases the demand for insulin and, by throwing extra strain on the islets of Langerhans, may lead to degeneration of the beta cells in experimental animals Obesity is firmly established as a cause of diminished carbohydrate tolerance in man and its relation to glycosuria and diabetes mellitus is well known When fat but otherwise healthy people are submitted to glucose tolerance tests, a large proportion of them are found to have curves which are somewhat higher and more prolonged than usual, or they are frankly diabetic If obesity is allowed to persist for a number of years it leads to diabetes in some but not all people If the body weight is reduced by dietary restriction to near the normal, glycosuria is very often abolished and the glucose tolerance curve may be restored to normal (Newburgh and Conn, 1939) It has been suggested that glycosuria associated with obesity should properly be regarded as a condition apart from ordinary diabetes In practice, however, it is by no means easy to make the distinction between harmless glycosuria and diabetes occurring in fat people Obesity is a common forerunner of diabetes which, clinically mild, is accompanied by degenerative complications as severe as those seen in ordinary diabetes

Physical inactivity

Blotner (1945) studied the sugar tolerance of a group of bedridden patients Glucose tolerance tests were carried out on 70 non-diabetic adults who had been confined to bed for periods varying between four weeks and eight years because of paralysis, arthritis and various chronic diseases Most of the patients were of normal or slightly below normal weight and only two had a family history of diabetes Of the 70 adults, 63 had abnormal glucose tolerance curves, having a fasting level of 70 to 130 milligrams per 100 millilitres, rising to a peak of 180 to

of the anterior pituitary and adrenal cortex exert a powerful influence on carbohydrate metabolism and regulation of the blood sugar They have the important function of maintaining life during prolonged starvation by accelerating the breakdown of stored fat and tissue protein with release of sufficient glucose and ketone bodies to ...

the body The blood sugar level is maintained within the narrow limits of normality, a fall to dangerously low levels during starvation being prevented by the intervention of the adrenal cortex and anterior pituitary and any abnormal rise after the ingestion of carbohydrate being prevented by an increase in the secretion of insulin Disorganization of the balance between these opposing hormones leads in one direction to spontaneous hyperglycaemia and in the other to diabetes mellitus The ...
opposing ...
tectomy ...
adrenal cortex showing that the diabetic state resulting from islet deficiency is due at least in part to the unopposed action of the other two glands Temporary diabetic states have been produced by administration of cortisone and also by administration of anterior pituitary extracts By suitably increasing the dose of anterior pituitary extract Young (1937) produced diabetes in dogs which persisted indefinitely after the injections ceased This permanent diabetes was found to be associated with degeneration of the insulin secreting cells of the islets of Langerhans Thus a temporary diabetic state was produced by these extracts but permanent diabetes depended on deficient insulin secretion due to islet damage. There is a parallel here with the early work of Allen ...

These considerati...
genesis of diabetes ...
affecting the capaci...
normal pancreas ha... ...and can respond to all the demands ordinarily made on it The functional reserve may be reduced by an inherent deficiency of the beta cells or by acquired disease or injury Factors known to increase the demand for insulin are over feeding and excess of the opposing secretions of the adrenal cortex anterior pituitary and thyroid glands

Aetiology of human diabetes

Pancreas

Pancreatectomy and gross disease of the entire pancreas, such as occurs in pancreatitis extensive destruction by malignant disease and haemochromatosis, result in diabetes Gross pathological changes are, however, a rare finding in diabetes and the islets may show only some degree of hyaline degeneration and fibrosis or may appear perfectly normal It is possible that improvements in ...

by over-taxing the normal storage mechanism. The slight glycosuria said to occur in some normal people after the ingestion of very large amounts of carbohydrate is not of clinical importance and it is now generally recognized that the normal storage mechanism is capable of dealing with all the sugar absorbed after meals or after the ingestion of 100 grammes of glucose or more. On this view, the occurrence of glycosuria after the ingestion of carbohydrate indicates a defect of assimilation or retention, and the term alimentary glycosuria is undesirable in that it directs attention to the absorption of glucose from the alimentary tract which is merely the agent whereby the essential defect is revealed. Slight lowering of the renal threshold permits glycosuria when the blood sugar rises after meals. If the renal threshold is normal, the glycosuria must be due to some disturbance of blood sugar regulation. This may be explained by rapid absorption from the intestine as in hyperthyroidism and after operations on the stomach, in which curves of the lag type are found. The transient hyperglycaemia of the lag curve is often missed because venous blood is used and the cause of unexplained post-prandial glycosuria may be revealed if the glucose tolerance curve is repeated using capillary blood. Most important of all is that the possibility of mild diabetes should not be dismissed without full investigation including a glucose tolerance test.

DIABETES MELLITUS

Diabetes mellitus is a chronic disorder of metabolism characterized by persistent hyperglycaemia and a tendency to premature degeneration of the vascular and nervous systems. Its clinical manifestations range from symptomless glycosuria to the classical syndrome of excessive thirst, polyuria and loss of weight. Disturbance of carbohydrate metabolism is most evident and diagnostically important but protein and fat metabolism are also affected. The conversion of protein to glucose in the liver leads to muscular wasting with increased loss of nitrogen in the urine and accounts for the persistence of glycosuria in severe diabetes even when no carbohydrate is taken by mouth. Fat is also broken down in the liver to ketone bodies which are used to supply the energy requirements of the tissues instead of glucose. In severe, untreated diabetes fat katabolism gathers momentum until ketone bodies are formed more rapidly than the tissues can use them. The excess is at first eliminated by the kidneys but ultimately, when excretion fails to keep pace with production, ketone bodies accumulate in the blood and the resulting state of ketosis, unless properly treated, may progress to coma and death.

All the biochemical disturbances of diabetes can be produced by removal or destruction of the pancreatic islets and corrected by the administration of insulin. Surgical excision of the pancreas was the first and is still the most certain method of producing diabetes in experimental animals. It was subsequently discovered that animals could be rendered diabetic without surgical interference by selective destruction of the insulin-secreting cells of the islets of Langerhans brought about by the injection of alloxan (Dunn and his colleagues, 1943). Yet the study of experimental diabetes has shown that deficient production of insulin is by no means the only factor concerned in the genesis of diabetes. The metabolic hormones

patient suggests the possibility of diabetes or thyrotoxicosis Other common complaints are of blurred vision due to osmotic changes in the eye, cramps and paraesthesiae from salt depletion, and constipation caused by dryness of the faeces arising from general dehydration Women may complain of pruritus vulvae or menstrual disturbances and men of balanitis or impotence Some patients first seek medical advice on account of recurrent boils and carbuncles or with symptoms related to diabetic neuropathy or one of the other chronic complications such as gangrene

Analysis of the early symptoms of patients attending a diabetic clinic showed that 77 per cent of them had diabetic symptoms of some kind, but only 34 per cent presented the classical symptoms of the disease Early diagnosis was found to be comparatively rare, the majority of the patients (80 per cent) having had glycosuria for two years or more before coming for treatment (Beaser, 1948)

Three clinical groups

Although diabetes does not lend itself to rigid classification, some simple form of clinical grouping is customarily adopted as a working basis for treatment For th

patients can be assigned to one or other group according to the body weight (fat, thin or medium is *often enough*) and nature of the symptoms at the time when the diagnosis is first made

Severe diabetes —The patients in this group present with the classical symptoms of thirst, polyuria, wasting and weakness Emaciation may be obvious at a glance and a history of recent loss of weight will be obtained unless the onset has been very recent Glycosuria is heavy and ketosis readily develops in the absence of treatment This is the characteristic form of diabetes in young patients, but may occur at any time of life *including* old age

in

or

occur either of the other kinds may also

Mild diabetes with obesity —The patients in this group are mostly women over forty years of age who are obviously fat With the single exception of pruritus vulvae there is a remarkable absence of symptoms which might suggest the presence of diabetes and consequently the diagnosis is often long delayed Patients in this group differ from those of the other two groups in that their diabetes is relatively resistant to the action of insulin and that diabetic ketosis rarely occurs

Diagnosis

Diabetes is easily recognized when it is *severe* and accompanied by typical symptoms It is the common cause of excessive thirst and urination and is readily

histological technique may reveal, in some of these apparently normal islets, defects in the number or structure of the beta cells, but in the present state of knowledge the absence of any specific post-mortem lesion so conflicts with experience in other pathological conditions, that we cannot safely assume that the pancreas is primarily at fault in every case.

Other endocrine glands

Diabetes occurs in 17 per cent of acromegalics and is a feature of Cushing's syndrome Such clinically recognizable endocrine disorders, however, account for only a very small proportion of cases of diabetes and the role of the pituitary and adrenal glands in the genesis of ordinary diabetes is still a matter for conjecture The fact that women who develop diabetes have often had large babies suggests that, at least in some instances, the growth hormone may play a part

Heredity

Heredity is firmly established as the major predisposing cause of diabetes 50 per cent of diabetic children have a family history of diabetes A likely but unproved hypothesis is that the infant is born with a hereditary defect of the islets of Langerhans which makes them incapable of responding to increased functional demands and predisposes to the development of diabetes in later life Careful studies have led to the view that the liability to diabetes is transmitted as a Mendelian recessive character (White and Joslin, 1952), but some authorities believe that this is an over-simplification and that the full mechanism of genetic transmission has yet to be unravelled

Obesity

Obesity is clinically the most important precipitating cause of diabetes and is found in more than half of the patients who develop diabetes after middle life Estimation of the insulin content of plasma has shown that elderly, obese diabetics have a normal output of insulin (Bornstein and Lawrence, 1951), and the cause of their diabetes must therefore be an increased demand for insulin The reason for this increased demand is not fully understood It is known that insulin is used for the conversion of carbohydrate, in excess of the immediate requirements of the body, to fat, according to one view the extra insulin required for the deposition and maintenance of fat in the depots may account for the increased demand for insulin in obesity Increased body weight is accompanied by abnormal resistance to the action of injected insulin of which unexpectedly large doses are required to lower the blood sugar Correction of the obesity restores insulin sensitivity, abolishes all clinical evidence of diabetes and may even cause the glucose tolerance curve to revert to normal

Clinical picture

The onset of clinical diabetes is sometimes abrupt and can occasionally be traced to a particular day, but usually in old people it is insidious with symptoms developing gradually, sometimes waxing and waning over a period of weeks or months Thirst, polyuria, wasting and muscular weakness are the most constant and characteristic symptoms The appetite is good or even excessive and the combination of a voracious appetite with progressive loss of weight in an afebrile

lost and the toes become cold and pale or cyanosed The impaired blood supply lowers the vitality of the tissues with the result that minor injuries are unduly slow in healing and may lead to an indolent ulcer or to diabetic gangrene The diabetic patient may be advised of certain practical measures to guard against [illegible] He sho ld be told to wash his feet at least once a day All [illegible] a diabetic clinic by a trained chiropodist [illegible] " or $\frac{3}{16}$" thick, is of great value in protecting corns and callouses The toe [illegible] ould be cut square and moderately short. Any ep dermophytosis should be vigorously treated with Whitfield's ointment [illegible]

[illegible] at night, but not a hot water bottle Elderly diabetics should not sit with their legs crossed The typical diabetic gangrene starts from a superficial injury and is due to the combination of ischaemia and neuropathy with superadded infection of the devitalized tissues Treatment includes careful control of the diabe [illegible] admini[illegible] from sw[illegible] limb is [illegible] body at [illegible] Raising the head of the bed may augment the peripheral blood flow sufficiently to relieve ischaemic pain persisting at rest. Vasodilator drugs of various kinds have been tried, the one in most general use at present being tolazoline hydrochloride (Priscol) of which the oral dose may be increased from 25 milligrams three [illegible] should be k[illegible] as low as p[illegible] after a trial [illegible] at amputation will be neces sary this should not be delayed too long

Diabetic neuropathy

The characteristic nervous lesion of diabetes is a peripheral neuropathy affecting chiefly the sensory fibres Its main symptom is pain in the legs which is generally worse at night and often severe enough to prevent sleep Sensations of burning, tingling, coldness and numbness are also common The physical signs include diminished vibration sense, absence of deep reflexes especially the ankle jerks, muscle tenderness loss of position sense in the feet, and cutaneous sensory impairment Less commonly there is motor involvement with weakness and wasting of muscles especially the quadriceps femoris or the muscles supplied by the peroneal nerve and sometimes there is partial or complete foot drop A conspicuous feature of diabetic neuropathy is that autonomic nerve fibres may be affected causing dependent oedema, absence of sweating over the feet, atrophic changes in the skin and trophic ulcers Other autonomic disturbances include orthostatic hypotension, periodical attacks of noct [illegible] of the bladder [illegible] that [illegible] resem[illegible]

distinguished from the polyuria of renal disease, diabetes insipidus or hysteria by examination of the urine. Even in the absence of other symptoms, it deserves consideration in cases of unexplained loss of weight, the association of progressive wasting with a good appetite being particularly suggestive The practice of testing *the urine of all patients with boils and other infections of the skin, balanitis or* pruritus valvae, altered vision, peripheral vascular disease and peripheral neuritis, leads to the discovery of a proportion of diabetics The problem of detecting the symptomless cases can be tackled only by extending the scope of routine urine testing in clinical practice and, on a larger scale, by detection drives of the kind which have been successfully conducted in America

In the presence of unmistakable thirst, polyuria and wasting the diagnosis can usually be made by examination of the urine, a definite reduction of the copper solution with yellow precipitate is sufficient to establish the presence of diabetes, especially if Rothera's test for ketone bodies is also positive Laboratory confirmation can be obtained by a single estimation of the blood sugar, preferably two hours after a carbohydrate meal, but glucose tolerance tests are unnecessary in such cases and involve delay in starting treatment

In the absence of classical symptoms, a firm diagnosis can be made only by blood sugar estimations (*see* page 135)

Complications

The complications of diabetes fall into two distinct groups The chronic complications consist of slowly progressive degenerative changes in the vascular and nervous systems leading to disease of the heart, limbs, kidneys and eyes The second group includes infections, and the various other acute complications which disturb the even course of the disease and which may lead to ketosis and coma Diabetic *coma has ceased to be a major cause of death, most of the ill-health and more than* 75 per cent of the deaths among diabetics being now due to the complications rather than to the disease itself The prevention of complications is therefore of prime importance The most grave consequence of infections and the more acute forms of neuropathy can be averted by good control of the diabetes The other complications are related to the duration of the diabetes and cannot be entirely prevented but there is no doubt that their severity is increased by failure to control the disease Although there is no final proof that hyperglycaemia itself is directly responsible for the development of complications, nevertheless treatment should aim at the maintainance of normal blood sugar levels as being the best index that the metabolism has been restored to normal

Atheroma and gangrene

Atheroma develops prematurely and progresses very rapidly in diabetic patients Its most serious effects arise from ischaemia due to occlusion of the coronary arteries and the arteries of the legs Atheroma of the coronary arteries is the commonest cause of death in middle-aged and elderly diabetics either from ischaemic *myocardial degeneration ending in heart failure or from coronary* thrombosis Disease of the peripheral arteries causes intermittent claudication and ischaemic changes in the feet The dorsalis pedis and posterior tibial pulses are

is to obtain the best possible control of the diabetes with insulin and to treat the infection on its own merits

Treatment

The treatment of diabetes has progressed in recent years by the introduction of

the fact that an excessive consumption of food is harmful in diabetes and that a restriction in intake of the total daily calories is beneficial During the ensuing years there ha been

ne

under weight whose diabetes is mild and can be controlled by a moderately restricted carbohydrate diet without insulin Finally there is the group who need insulin, and this includes the under weight and those with complications or ketosis

If Rothera's test is negative or only weakly positive, treatment may be safely started at home or in an ... sis or

used

... ge doses disproportionate to the mildness of their metabolic disorder Insulin also has an additional disadvantage that of stim lat ...

... the estimated daily requirement, but in actual practice the more satisfactory plan is to start arbitrarily with a 1000 calorie diet which may be increased to 1200 or 1400 calories if weight loss is too rapid In favourable cases the urine becomes sugar free within a few days and diabetic control presents no difficulties except during acute infections, when the temporary administration of insulin may be necessary When the desired weight is reached, the diet is increased to prevent further loss, but some restriction of calorie intake will be permanently necessary Urine tests are essential to mak

the diabetes is prope

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urine is ... eight by dieting, in spite of every effort by doctor and dietitian The failure may sometimes be due to deliberate disregard of advice but occasionally one meets with a patient whose appetite seems to be beyond conscious control This may be ...

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... of mild diabetes by diet without insulin

Patients who are of average weight and free from ketosis can safely be given an initial trial on a restricted carbohydrate diet without insulin Treatment is begu

Ocular complications

Retinopathy is common in long-standing diabetes but, fortunately, causes little interference with vision unless the macular area is involved The earliest lesions are minute rounded aneurysms arising from the retinal capillaries Later there are haemorrhages and clusters of waxy exudate over the posterior pole of the fundus oculi Repeated retinal haemorrhages may lead to retinitis proliferans, a grave complication in which strands of fibrous tissue extend forwards from the retina into the vitreous, leading to retinal detachment and blindness Ordinary senile cataract is common but true diabetic cataract, affecting children, is fortunately rare

Renal complications

The specific renal lesion of diabetes is a hyaline degeneration of the glomerular capillaries described by Kimmelstiel and Wilson (1936) It is distinguished in *histological preparations by a tendency for the hyaline material to coalesce into* nodular masses at the centre of the glomeruli The clinical features are albuminuria, oedema, hypertension and retinopathy of both hypertensive and diabetic types The prognosis is bad It is important to bear in mind that chronic pyelonephritis can produce the same clinical picture and that a careful search should be made in such cases for evidence of urinary infection Infections of the urinary tract occur chiefly in women They are difficult to cure and are liable to relapse if the urine contains sugar Vigorous treatment is necessary to prevent permanent renal damage from chronic pyelonephritis The urine is cultured and, according to the result of sensitivity tests, the appropriate antibiotic is given in a dosage calculated to produce a bactericidal and not merely bacteriostatic concentration Prolonged and persistent treatment may be necessary Every effort should be made to render the urine sugar-free, and the presence of a calculus or any obstructive lesion in the urinary tract should be sought for and dealt with

Other infections

A characteristic feature of diabetes is that it is made worse by infections The presence of an acute infection may lead to sudden intensification of the diabetic state requiring rapid and very considerable increase in the dose of insulin to prevent ketosis Patients whose diabetes is controlled do not seem to be abnormally prone to develop infections Those with uncontrolled diabetes have an increased susceptibility to certain infections especially of the skin and urinary tract Boils and carbuncles are common and often continue to recur until the diabetes is properly controlled Unexplained ill health and loss of weight suggest the possibility of pulmonary tuberculosis An annual x-ray of the chest is advisable to detect symptomless cases Susceptibility to tuberculosis is greatest in young, under-weight patients whose diabetes is badly controlled Advances in the chemotherapy and surgical management of pulmonary tuberculosis have materially improved the outlook in this formerly rather sinister combination of diabetes and tuberculosis Proper supervision of the diabetes is of equal importance and patients can be transferred with great benefit to special centres where adequate facilities exist for the management of both conditions The principle of treatment in all infections

by protamine zinc insulin alone More severe cases need the addition of soluble insulin to control glycosuria during the day The disadvantage of protamine zinc insulin is that it acts as strongly by night as by day and post prandial control is not really effective It seems probable that in the future the new lente insulins will largely replace protamine zinc insulin

Mixed protamine zinc insulin and soluble insulin —More severe cases can be controlled by a single morning injection of protamine zinc insulin and soluble insulin given together in the same syringe It is essential that soluble insulin should be taken into the syringe first before the protamine zinc insulin is withdrawn ... h ch converts part of

the proportion of two parts of soluble insulin to one part ... insulin suits the majority of patients It is advisable not to allow the dose of protamine zinc insulin to exceed 40 units per day because of the danger of severe and prolonged hypoglycaemic reactions If this is not sufficient to render the early morning urine sugar free, an additional small dose of soluble insulin may be given in the evening

Insulin zinc suspensions —Hallas Møller and his colleagues (1952) found that when minute quantities of zinc are added to insulin without additional foreign protein substances, a slowly soluble complex is produced, the use of an acetate buffer instead of the usual citrate or phosphate enables additional zinc to be combined with the insulin thus lowering its solubility If the pH is raised quickly during the preparation of the material an amorphous precipitate forms The amorphous or semi lente type has an action of about 12 hours because of the smaller size of the particles The large size of the particles in the ultra lente type gives an action up to 36 hours In common use at the present time is lente insulin which consists of three parts of the amorphous or semi lente insulin and seven parts of the crystalline or ultra lente insulin having an action lasting abo it 24 ho ... single morn ... diabetes T ... with the a ... is more simple to use because it does not involve mixing two insulins before injection Patients whose diabetes is badly controlled on the older types of insulin should be changed to the new lente insulins in an attempt to get better metabolic regulation Finally there are some ... who are allerg ... but who are f ... of 8 units or ... or moderate glycosuria without ketosis, and the dose is increased by 4 units every third day until the diabetes is controlled

... was balanced insulin zinc suspension must not be mixed with soluble insulin but its action can be shortened by the addition of amorphous insulin zinc suspension (semilente) or lengthened by the addition of crystalline insulin zinc suspension (ultralente)

with a diet containing 120 grammes of carbohydrate divided equally between the meals If, after a week on this diet, the urine is sugar-free, the carbohydrate is slowly increased until it is sufficient to allow the patient to maintain weight and strength while continuing his normal activities If glycosuria persists on 120 grammes of carbohydrate, or reappears before enough carbohydrate is being taken to maintain the body weight at a steady level, the diet must be increased to 150 grammes of carbohydrate and insulin given During acute illnesses and other crises, patients whose diabetes is, at ordinary times, well controlled by diet may need insulin.

Diet and insulin

Insulin is best given from the beginning to patients who are under-weight, or ketotic, and to all diabetic children. Stabilization is easier if the carbohydrate intake is fairly low at first, usually 150 grammes, until the diabetes is controlled It will often be found that the carbohydrate can then be increased in stages, with little increase of insulin, up to the full amount on which the patient is well and maintains his ideal weight while at work Adjustments of the carbohydrate allowance may be necessary from time to time to counteract any tendency to an increase or decrease in weight Provided the protein and fat foods are taken in ordinary amounts and without great variation from day to day, they need not be weighed This has the advantage of leaving the patient free to concentrate on taking the correct amount of carbohydrate foods

Insulin

The choice lies between starting with soluble (unmodified) insulin or one of the slow-acting insulins Soluble insulin has the advantage of bringing the diabetes more quickly under control and is used in the management of ketosis, in surgery and in all urgent cases It has the disadvantage that two or sometimes three injections a day have to be given Once the diabetes is controlled it is a simple matter to change over to a slow-acting insulin, or insulin mixture, if desired Insulin zinc suspensions or other slow-acting insulins may be given from the start in the ambulant treatment of milder cases without ketosis

Soluble insulin.—This has the shortest action of all insulins and is injected before the breakfast and chief evening meal A suitable starting dose for out-patients is 12 units in the morning and 8 units in the evening Each dose is then increased by 2 units daily until the urine passed at noon is sugar-free If the urine passed at 6 p m or before breakfast still contains much sugar, the morning or evening dose respectively is gradually increased During this process hypoglycaemic symptoms may occur at noon or in the early part of the night, and can be counteracted by giving extra "buffer meals" of 10–20 grammes of carbohydrate at mid-morning or bed time

Protamine zinc insulin.—This has a prolonged action lasting over the whole 24 hours It can therefore be given in a single morning injection, starting with 8

... the addition of soluble ... age of protamine zinc ... post prandial control is ... new lente insulins will largely replace protamine zinc insulin

Mixed protamine zinc insulin and soluble insulin—More severe cases can be controlled by a single morning injection of protamine zinc insulin and soluble insulin given together in the same syringe It is essential that soluble insulin should be taken into the syringe first before the protamine zinc insulin is withdrawn Protamine zinc insulin contains an excess of free protamine which converts part of the soluble insulin to protamine zinc insulin The result is that the soluble insulin has little effect unless its dose exceeds that of protamine zinc insulin, a mixture in the proportion of two parts of soluble insulin to one part of protamine zinc insulin suits the majority of patients It is advisable not to allow the dose of protamine zinc insulin to exceed 40 units per day because of the danger of severe and prolonged hypoglycaemic reactions If this is not sufficient to render the early morning urine sugar free, an additional small dose of soluble insulin may be given in the evening

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Globin and isophane insulins—These have a longer action than soluble insulin but shorter than protamine zinc insulin Given as a single injection before break fast globin insulin suits some patients well, controlling glycosuria during the day without causing hypoglycaemic attacks at night Other patients, especially those who need 40 units or more daily, are troubled by severe hypoglycaemic reactions in the late forenoon or afternoon Isophane insulin, popular in the United States of America, has been little used in this country and, like globin insulin, is being replaced by the insulin zinc suspensions

Choice of insulin—Relatively mild cases with a low insulin requirement are rapidly controlled with a single dose of any of the slow-acting insulins For the more severe cases a mixture of soluble insulin and protamine zinc insulin has been most widely used, supplemented in the severest cases with an evening injection of soluble insulin It seems probable that insulin zinc suspensions will supplant the soluble insulin and protamine zinc insulin mixture for general use

Local reactions to insulin—Allergic reactions arise most commonly from the use of protamine zinc insulin and only rarely from other insulins Local reactions appear at the site of the injections as red tender swellings lasting several days and there may also be generalized urticaria and other allergic symptoms These reactions commonly occur within the first five days of treatment but subside spontaneously within a few months during which an antihistamine drug may be given to relieve the symptoms A change from protamine zinc to soluble insulin or insulin zinc suspension is often effective and only occasionally will desensitization be necessary, a minute dose of insulin being injected subcutaneously and followed by increasing doses,

Fat atrophy—This is a rare and unsightly complication of insulin therapy in which the subcutaneous fat disappears at the site of the injections leaving ugly hollows It is practically confined to women and the cause is unknown Affected patients should take special care to plan out the sites at which the injections are made so that the same site is not used more than once in six weeks

Surgical operations

Surgical intervention in elderly diabetics is most commonly needed for gangrene, and should be as conservative as possible Local amputation of toes is a successful procedure If a more extensive amputation is needed, it should where possible be below the knee, provided that vascularity is sufficient to permit healing of the skin flaps A below-knee prosthesis produces a better functional result than one above the knee Controlled diabetes is no contra indication to essential surgery, but in deciding on elective surgery the probability of advanced arterial disease should be taken into account with its special dangers of post operative coronary thrombosis and thrombosis in the arteries of the legs or brain Uncontrolled diabetes and especially ketosis adds greatly to the risk of surgery Therefore, except in the most acute surgical emergencies, time should be allowed to get rid of ketosis and to bring the diabetes under good control During this period the patient should have a diet containing at least 150 grammes of carbohydrate and should be treated with two or more daily injections of soluble insulin in preference to the slow acting preparations Operations under local anaesthesia do not require

any special preparation If a general anaesthetic is to be used, an adequate supply of glucose and insulin must be given on the day of operation to prevent ketosis A common practice is to give 50 grammes of glucose in water by mouth two hours before the operation, accompanied by the usual morning dose of insulin This is open to the objection that some fluid may remain in the stomach and be regurgitated and perhaps aspirated into the lungs during the anaesthetic To avoid this risk the stomach should be emptied through a Ryle's tube before the anaesthetic is started A safer and more reliable method is to set up before the operation a continuous intravenous infusion of 5 or 10 per cent glucose and to divide the daily dose of insulin, on which the diabetes was stabilized before the operation, into equal fractions given at 6-hourly intervals In the post operative period the dose of insulin is adjusted according to the results of the blood sugar and urine tests Nitrous oxide and oxygen, thiopentone and cyclopropane cause little disturbance Ether has the disadvantage of post anaesthetic vomiting but is useful and harmless enough, when used in small quantities as an adjuvant to nitrous oxide and oxygen Chloroform should never be used because of its toxic action on the liver

HYPOGLYCAEMIA

Diabetics differ greatly in their liability to insulin reactions There are some who suffer little or not at all

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taneous impro ... or to a mistake in treatment such as an overdose of insulin a delayed meal or failure to take extra carbohydrate before unaccustomed exercise

Symptoms

Early symptoms, thought to be caused by liberat

... of hypoglycaemia may be betrayed to an onlooker by something unusual in the demeanour of the patient, defiance or unwonted *hilarity* a wooden stare or confusion in answering questions Untreated severe cases may have *ataxia*, paresis, convulsions and finally coma

It is important that patients should learn to recognize for themselves the earliest symptoms of hypoglycaemia This the majority can do, fortunately, despite the diversity of the symptoms one symptom or group of symptoms generally recurs in a particular patient with sufficient regularity to be easily identified Difficulty arises when familiar warning symptoms are

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in a freshly passed specimen of urine consist chiefly of beta hydroxybutyric acid with about 30 per cent of aceto acetic acid and only a small *quantity of acetone* Their presence in urine can be detected by Rothera's nitroprusside test which is extremely sensitive Gerhardt's ferric chloride test becomes positive only when a large quantity of aceto acetic acid is present, indicating that ketosis has reached a serious stage Recently a simple tablet test (Acetest) has been introduced which, although less delicate than Rothera's test, is quite satisfactory for ordinary clinical purposes A drop of urine is placed on the tablet and if ketone bodies are present a purple colour develops

Diabetic coma can be prevented if ketosis is treated in its early stages by increasing the dose of insulin If a mixture of protamine zinc and soluble insulins is being used the soluble insulin should be increased and, if glycosuria persists to the evening test, an additional dose of soluble insulin may be given before the evening meal If there is difficulty in controlling ketosis in a patient having a slow acting insulin it is better to change to soluble insulin which can be given more frequently and increased more quickly By giving supplementary injections of 8 12 units at noon and midnight the total daily dose of insulin can be safely and rapidly raised

As ketosis increases, the appetite fails and there may be vomiting and abdominal pain The patient becomes apathetic and shows increasingly deep breathing and drowsiness At this, the stage of pre-coma, vigorous treatment is needed with *soluble* insulin given every 4 hours, the amounts depending on the blood sugar level and urine tests The carbohydrate allowance should be generous and divided into equal feeds of about 40 grammes every four hours

Diagnosis

Diabetic coma is easily recognized when it occurs in a known diabetic with the typical history of recent heavy glycosuria, thirst and gastro intestinal symptoms followed by gradual deterioration of health, and drowsiness increasing to coma The outstanding physical signs are the deep abdominal breathing of air, hunger and for those who can detect it the strong smell of acetone in the breath Evidence of general dehydration is seen in the shrunken appearance of the
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Special care is needed in making the diagnos ...
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character of diabetic coma Large doses of insulin may prove fatal and should be withheld in case of doubt until the blood sugar level is kno ...
between diabetic coma ...

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Insomnia, difficulty in rising in the morning and malaise that clears up with breakfast are also suggestive

In dealing with a condition of such variable symptomatology, the practitioner is well advised to bear in mind the possibility of hypoglycaemia when confronted with any unusual symptom in a diabetic patient having insulin Reactions from soluble insulin, given in the usual way before meals, are most likely to occur *3-4 hours after the injection but the interval may be longer after large doses of* over 40 units The most likely times for reactions from globin insulin given in the morning are the late forenoon and afternoon, and for protamine zinc insulin during the night and before breakfast Insulin zinc suspension may cause hypoglycaemia at any time in the 24 hours, most commonly at the end of the morning

Hypoglycaemic coma

The diagnosis of hypoglycaemic coma from diabetic coma is discussed on page 157 Coma of sudden onset in a patient having insulin is likely to be hypoglycaemic in which case administration of insulin may be fatal Every diabetic treated with insulin should, therefore, carry a card giving particulars of his name, his doctor or hospital, the type and dose of insulin and the following direction

> THE BEARER OF THIS CARD IS A DIABETIC AND TAKES INSULIN
> IN THE EVENT OF SUDDEN CONFUSION OR FAINTNESS PLEASE GIVE
> *TWO TABLESPOONFULS OF SUGAR IN WATER AND COMMUNICATE*
> WITH THE NEAREST DOCTOR

Suitable cards can be obtained from the British Diabetic Association, an organization for the benefit of diabetics which they are well advised to join

Treatment

Insulin patients should invariably have with them a supply of sugar or other carbohydrate and at the first symptom of hypoglycaemia should at once take two lumps of sugar or the equivalent and keep at rest until the symptoms have passed In mild reactions this will suffice but if the symptoms persist for half an hour or if they recur (as happens in reactions due to protamine zinc insulin), the dose should be repeated and if this is still not followed by improvement, 1 ounce (30 grammes) of glucose should be given, well diluted, by mouth

If the patient is already unconscious the best treatment is to give at least 5 grammes of glucose intravenously which can be done conveniently by injecting 20 millilitres from an ampoule of 25 per cent glucose If facilities are not available for giving glucose intravenously, a subcutaneous injection of 1 millilitre of a 1 in 1000 solution of adrenaline may release enough glucose from the liver glycogen to restore consciousness sufficiently to allow sugar to be given by mouth If this fails glucose may be given by stomach tube

DIABETIC COMA

Diabetic coma is the final outcome of ketosis resulting from uncontrolled diabetes Ketosis is due to increased production of ketone bodies by the liver and not, as was formerly believed, to failure of the tissues to oxidize them The ketone bodies

Fluids

Diabetic coma is associated with severe depletion of water and electrolytes which must be corrected by the intravenous administration of fluid The main losses of electrolytes are sodium and chloride from the extracellular fluid and potassium magnesium and phosphate from the cells The first and immediate need is to combat circulatory failure by restoring the blood volume with sodium chloride and water Physiological saline is often used but is not ideally suited to this purpose because sodium is lost in greater proportion from the extracellular fluid than is chloride A more satisfactory solution consists of sodium chloride with a proportion of sodium lactate which provides the extra sodium and helps to correct acidosis The composition of this saline lactate solution is as follows *Sodium chloride* 5 85 grammes sodium lactate 3 36 grammes distilled water *to 1 litre* (Nabarro and his colleagues 1952) Whether physiological saline or the saline lactate solution is used the infusion is allowed to run in rapidly at first to restore the failing circulation The rate of administration is adjusted to the size of the patient and the state of the circulation but usually two litres are given in the first hour after which the infusion is slowed to deliver a litre every six hours The consensus of opinion is now against the use of glucose at this early stage when the blood sugar is high It increases the urinary loss of water and electrolytes and interferes with the reliability of blood sugar estimations

When the blood sugar begins to fall the saline or saline lactate is replaced by a solution containing glucose and suitably balanced to replace the potassium and o he el

[illegible] serum potassium falls The course of the potassium deficiency can be followed by the electrocardiogram the flattened T waves characteristic of potassium depletion being restored to normal as the potassium deficiency becomes corrected A suitable formula for the cellular replacement fluid is given by Nabarro as follows *Sodium chloride* 1 17 gramme dipotassium hydrogen phosphate 0 87 gramme potassium chloride 1 49 gramme magnesium chloride 0 24 gramme glucose 50 0 *grammes distilled* water to one litre This is continued at the rate of a litre every six hours until oral feeding is established Intravenous administration of potassium is dangerous if the urinary output is reduced or if given in too great a concentration *If* a suitable solution is not available glucose saline (4 3 per cent glucose and 0 18 per cent sodium chloride) may be used instead

As soon as insulin has been given and an intravenous infusion set up it is a wise plan to pass a wide bore stomach tube if there is any sign of regurgitation or gastric dilatation The stomach may be washed out with warm water or saline but care should be taken that the stomach is left empty No attempt should be made to give fluids or food by mouth because of the danger of regurgitation and inhalation

In every case of diabetic coma a careful search including an x ray of the chest should be made for an infection or other precipitating cause After recovery an enema will be required to empty the bowel of hard faeces

in insulin coma has usually been in normal health until a few minutes, or at most hours, before losing consciousness The main points of distinction between diabetic coma and insulin coma are as follows

	DIABETIC COMA	INSULIN COMA
Onset	Gradual	Relatively sudden
Skin	Dry	Often sweating
Respiration	Deep, abdominal	Normal
Breath	Smells of acetone	Normal
Glycosuria	Heavy	Moderate or nil
Ketonuria	Present	Absent

Changes in the reflexes and minor variations of eyeball tension may be misleading The presence of sugar in the urine does not necessarily exclude insulin coma because the sugar may have entered the bladder some hours before, when the blood sugar was still high When it is impossible on clinical grounds to decide if an unconscious patient is suffering from diabetic or insulin coma, it is best to collect blood for a blood sugar estimation and then to try the effect of an intravenous injection of glucose

Treatment

Diabetic coma is a grave contingency which needs immediate hospital admittance In perhaps no other medical emergency are good laboratory facilities so essential Blood is collected for determination of blood sugar and alkali reserve and then without waiting for the result, the first dose of insulin is given and an intravenous saline infusion is started The patient should be kept warm and the foot of the bed raised

Insulin

Recovery depends largely on giving sufficient insulin and giving it early The initial dose is usually 100 units for an adult of which one-fifth is given intravenously and the rest subcutaneously The result of the blood sugar test should be known within an hour, and should this be over 800 milligrams per 100 millilitres another 80 100 units or more may be given Further injections of insulin are given at intervals of three hours the dose being adjusted according to the results of blood sugar tests and the clinical condition of the patient The previous dose may be increased by 50 per cent if there has not been any improvement and doubled if the blood sugar is actually higher Early cases of average severity need a total of only a few hundred units of insulin but patients who have been in coma for many hours and are gravely ill may need many hundreds of units and in such cases the insulin may sometimes have to be given at short intervals of ½–1 hour These very large doses of insulin are, however, only needed in exceptional cases and demand close supervision and frequent blood sugar estimation Large doses of insulin may be given with little risk of hypoglycaemia in the first few hours of treatment when insulin resistance is high As ketosis disappears the insulin sensitivity returns and the dose of insulin must then be reduced and always accompanied by glucose to guard against hypoglycaemia

Fluids

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HOME CARE OF THE DIABETIC

Whilst the general practitioner is responsible for the care of the patient at home he can obtain a great deal of help from the home nurse or health visitor The difficulties in the home care of the elderly diabetic are considerable and an excellent scheme has been organized in Cardiff for the follow-up and care of ex-hospital patients Patients, after discharge from hospital, are invited to attend a special diabetic clinic run by specially trained health visitors under the direction of the hospital physician Weekly visits are made to the hospital by the health visitors, who visit patients who are about to be discharged in both medical and surgical wards In this way they are able to gain the confidence of the patients and discuss with them the details of their future mode of living The special problems of each individual are discussed with the hospital staff and the health visitor notes any special instructions that may be required for the after-care of the patient When the patient is discharged from hospital a copy of the letter to the general practitioner is sent to the health visitor and the patient is visited at home Printed instructions are very rarely understood adequately by the elderly and it is far more satisfactory that essential matters, such as care of the feet, general hygiene, and storage of syringes should be supervized personally Many elderly patients find difficulty in measuring correct doses of insulin and they have also difficulty with diet Strict insistence on caloric control for over-weight patients must usually be sacrificed after the age of seventy when outside interests are contracting and contentment depends more on the comforts of the home At the clinic, patients are instructed in urine testing and taught to recognize the early symptoms of hypoglycaemia A chiropodist is in attendance and regular cookery demonstrations are given under the supervision of a qualified dietitian The whole scheme is under the supervision of a consultant physician Similar schemes for after-care could certainly be used with advantage more widely A small number of elderly diabetics without anyone to look after them are best cared for in a home, and a start has been made by the British Diabetic Association in establishing old peoples' homes, although accommodation of this kind remains scarce

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CHAPTER 7

CHRONIC BRONCHITIS IN THE ELDERLY

F J FLINT

INTRODUCTION

THE BRONCHITIC patient is well-known to all who practise medicine, particularly those working in the industrial cities of England, yet the pathological entity of chronic bronchitis has been denied by many eminent pathologists The syndrome of a spasmodic wheezy cough recurring every winter with greater intensity, tenacious mucopurulent sputum and progressive breathlessness on exertion, although sometimes mimicked by other respiratory diseases, may be aptly labelled "chronic bronchitis" The severity of its symptoms is determined by the relative frequency and virulence of infection, by the vitality of the broncho respiratory tract and its susceptibility to obstruction by mucus or spasm, and especially by the functional capacity of the lungs, it is not directly influenced by the age of the patient Bronchitis in the elderly, apart from that accompanying influenza and certain other virus infections is not necessarily a serious disease Possibly because of acquired resistance, many old people withstand the common cold better than the young They tend to stay at home and are thus less exposed to the risk of infection During the course of acute respiratory infections the bronchitic with marked emphysema, whether young or old, *is in grave danger of death from respiratory failure* (Westlake, 1954) Although the elasticity of the lungs decreases with advancing age, the most severe forms of emphysema are encountered in the middle aged, but because of antibiotic therapy the number of respiratory cripples among the elderly population is likely to increase

The duration of bronchitis is variable, and although the disease may originate in *early life, even in infancy there is an important group with symptoms of later onset* In some the original damage is due to an attack of whooping cough in infancy, in others to influenza in adult life, even in old age, but bronchitis is a well-known accompaniment of left ventricular failure and often precipitates congestive heart failure even in patients without chronic lung disease (Flint, 1954 b) Bronchitis is of course the feared accompaniment of many diseases in elderly people, particularly those undergoing operations or confined to bed for any reason, as *well* as those with impaired cardio respiratory function Old age is so often accompanied by multiple disease that bronchitis may be difficult to detect If the cough and ventilation are feeble, the suffocating effect of a respiratory infection may not be diagnosed until too late

The symptoms attributed to "chronic bronchitis" may be due to a number of other causes, especially chronic fibroid tuberculosis, bronchial carcinoma which

may persist for a considerable time in the elderly, and bronchiectasis In these diseases as in chronic bronchitis the disability is usually related to the function of the lungs rather than to the extent of the bronchial disease This principle applies particularly in bronchiectasis If the disease is of the diffuse type and associated with emphysematous changes in the lungs the prognosis is relatively bad, but the localized form even if severe is seldom serious Much depends on the efficiency of natural bronchial drainage In the writer's experience, upper lobe bronchiectasis is quite common in the elderly, and although often mistaken for more serious lesions, it seldom causes serious symptoms (Fig 35)



Fig 35 — Skiagram of chest Left upper lobe bronchiectasis in a man aged 71 with symptoms of chronic bronchitis (over penetrated film)

Death from chronic bronchitis

D[illegible]

per [illegible]

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unc[illegible]

Rar[illegible]

high[illegible] elderly men (Fig 36) the peak level of the death rate in 1940 was due to a change in methods of certification [illegible] for bronchitis is particularly

PATHOLOGY OF CHRONIC BRONCHITIS

By microscopic examination of serial sections of the lung Reid (1954) has given an excellent description of the pathological changes in the lungs and air passages

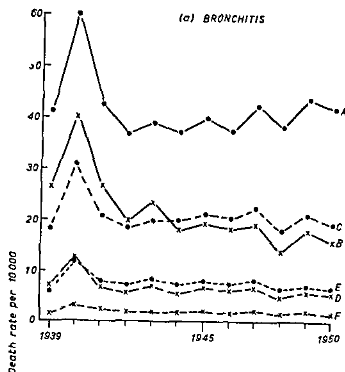
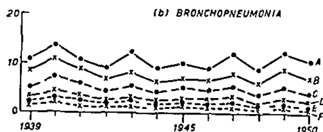


Fig 36 —Bronchitis and bronchopneumonia death rates for the years 1939 50 in England and Wales

A—Men aged 65 74 B=Women aged 65-74 C=Men aged 55 64 D—Women aged 55 64 E=Men aged 45 54 F=Women aged 45 54

(By courtesy of Mr Goodman Drs Lane and Rampling and the British Medical Journal)



Air passages

Early cases

In early cases the principal feature is hypertrophy of the mucus-secreting elements, which is corroborated by the excess of mucus in the air passages There is an obvious increase in the number of goblet cells, and the mucous glands, which are confined to the bronchi, also show hypertrophy, the ducts of these glands are often dilated and on bronchography this gives the appearance of diverticulosis so often seen in bronchograms of patients with chronic bronchitis There is usually oedema of the bronchial wall with swelling of the basement membrane and also some infiltration with round cells

Advanced cases

In advanced cases these changes are more marked and the ciliary mechanism ... The lumen of the smaller bronchi and bronchioles is ...

there is ... spread throughout both lungs and can be demonstrated ... bronchitis Simon ... variation ... dilatation; of the bronchial calibre ... bronchial diverticulosis, "peripheral pooling", and poor filling of the smaller bronchi and bronchioles Because of inadequate drainage of the small bronchioles

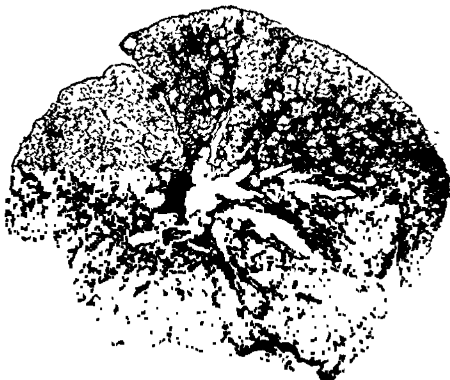


Fig 37 —Cross-section of whole lung showing diffuse emphysema Male patient, aged 62, who died of heart failure (*By courtesy of Dr Hatrack and Mr Lambourne*)

superadded infection usually gives rise to purulent bronchitis, abscesses which are often too small to be seen by the naked eye, and permanent obliteration of the lumen

The lungs

The changes in the lungs which are largely the ... are Pneumonia, organization of pn... collapse, and mucus and pus lying in

very small and patches of pneumonia are often only a few millimetres in diameter On occasion, organization of pneumonic exudate takes place with consequent contraction Patches of collapse usually measure about 0 5 centimetres in diameter but *serial sections show that they are supplied by large proximal bronchioles*, and therefore represent the remains of a considerably larger volume of normal functioning lung

The most important result of chronic bronchitis is emphysema, a change which, although varying in degree, is usually generalized throughout the lung (Fig 37) At least five mechanisms are probably concerned in its development (1) Disruption of alveoli, (2) dilatation of and cyst formation in bronchiolar remnants, (3) emphysema compensatory to disease in neighbouring lobules, (4) over-inflation of cystic areas caused by trapping of air during inspiration in persons with bronchospasm or excessive mucus formation, and (5) degenerative changes in the elasticity of the lung due to the process of ageing The lung thus becomes over-inflated, a feature which is well known both clinically and radiologically (Fig 38*c*)

RESPIRATORY FAILURE

After a prolonged period, usually 20 to 30 years, but in elderly subjects sometimes much less, the irreversible lung damage inseparable from chronic bronchitis may eventually become so advanced that respiratory failure ensues. The distribution of inspired air throughout the lungs in emphysema is exceedingly uneven and inefficient The function of the lung is impaired by (1) Perfusion of unventilated or under-ventilated alveoli, (2) ventilation of unperfused and under-perfused alveoli, and (3) widespread destruction of lung issue When the disease is far advanced the pulmonary reserve is so poor that a comparatively trivial bronchial infection may interfere with gaseous exchange, thus giving rise to a dangerous state of hypoxia and hypercapnia which may prove rapidly fatal (Westlake, 1954)

Pulmonary heart disease (cor pulmonale)

Anoxic pulmonary heart disease or cor pulmonale is but the end result of prolonged or repeated respiratory failure Not all bronchitics, however, reach the stage of heart failure In a series of 64 male cases of uncomplicated cor pulmonale studied by the author (Flint, 1954a), 49 were between 50 and 69 and only 3 over 70 years of age Cor pulmonale is probably not uncommon in the elderly but is liable to be associated with other forms of heart disease, particularly coronary atherosclerosis Cor pulmonale is rare in women but bronchitis in the elderly is a common accompaniment of heart failure due to other causes, a combination which carries a high mortality (Flint, 1954b)

It is over a hundred years since Laennec (1826) described the clinical and pathological characteristics of emphysema and observed that advanced lung disease may cause heart failure even in persons with healthy hearts What he said is as follows

> All diseases which give rise to severe and long continued dyspnoea produce, almost necessarily, hypertrophy or dilatation of the heart, through the constant efforts the organ is called on to perform, in order to propel the blood into the lungs against the resistance opposed to it by the cause of the dyspnoea When, however, diseases of the heart are found to coexist with chronic pleurisy, phthisis, emphysema, and, in

(a)

(b)

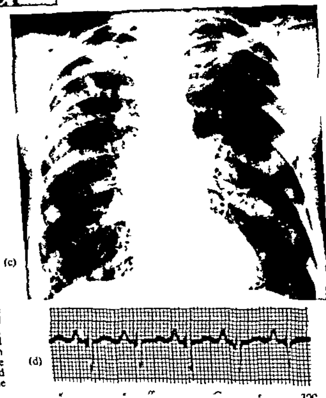


Fig 38 —(a) Transverse section of a normal pulmonary arteriole from a man who died following a prostatectomy and in whom there was no evidence of heart or lung disease The wall of the vessels consists of a single elastic lamina lying between the intima and a thin adventitia The vessel is indistinguishable from a pulmonary venule (Verhoeff's and van Gieson's stains 300 Diameter of vessel 55μ) (b) transverse section of a pulmonary arteriole from a man who died from emphysema with cor pulmonale In this case the heart weighed 400 grammes and the right ventricle was hypertrophied indicating the existence of pulmonary hypertension during life There is a distinct media in the pulmonary arteriole with definite internal and external elastic laminae. The adventitia is thick and there is intimal proliferation of fibrous tissue These features are abnormal and are characteristic of the

(c)

(d)

very small and patches of pneumonia are often only a few millimetres in diameter On occasion, organization of pneumonic exudate takes place with consequent contraction Patches of collapse usually measure about 0·5 centimetres in diameter but serial sections show that they are supplied by large proximal bronchioles, and therefore represent the remains of a considerably larger volume of normal functioning lung

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RESPIRATORY FAILURE

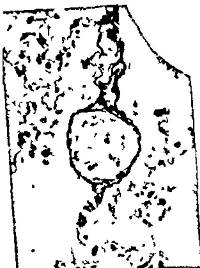
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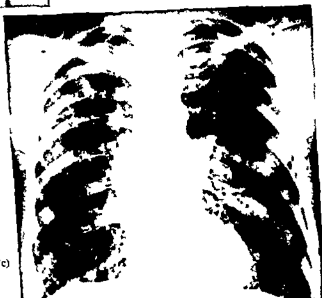
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(c)



(d)

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general, with chronic disease of the lungs, it will usually be found, on close examination that the latter are the primary diseases It follows from these, and other facts noticed under the head of emphysema and pulmonary catarrh, that a neglected cold is frequently the original cause of the most severe diseases of the heart

Until recent years, however, heart failure in patients with emphysema was commonly believed to be due to associated heart disease

White and Brenner (1933) wrote

> A true cor pulmonale (or pulmonary heart disease) is distinctly rare, it is present in certainly not much over 1 per cent of patients with heart disease Ordinarily asthma emphysema, and pulmonary tuberculosis, even though of high degree, do not produce *cor pulmonale*

Parkinson and Hoyle (1937), holding the same view, said

> Cardiac failure from emphysema alone is surprisingly rare, and when it occurs it is with normal rhythm and oedema, and as a very late event which is almost invariably terminal Recurrent bouts of failure are almost unknown Examples of failure apparently due to emphysema are most often explained by associated cardiovascular disease, usually hypertension, and in such failure can be recurrent

Kountz and Alexander (1934) were of the opinion that a cardiac lesion was rare in most cases of emphysema, but two years later (Kountz and his colleagues, 1936) their observations led them to hold the opposite view

Interest in pulmonary heart disease has only been aroused during the past ten or fifteen years This interest is largely due to re-assessment of the problem of heart failure by Cournand, Richards, and others, using new methods of investigation, notably cardiac catheterization, measurement of renal blood flow, blood gas analysis, respiratory function tests, and multiple unipolar-lead electrocardiography

It has been shown in cor pulmonale that, whereas the right ventricle is hypertrophied, the heart muscle is usually healthy (Laennec, 1826, Thomas, 1951, Fulton, 1953), the essential abnormality being gross pulmonary insufficiency (Richards, 1947, Taquini and his colleagues, 1948, Baldwin and his colleagues 1949) Platts (1953) showed that, whereas in other forms of heart failure the blood gases are nearly normal, in cor pulmonale the oxygen saturation of arterial blood is always below 72 per cent and the carbon-dioxide content above 60 volumes per cent

In severe emphysema the pulmonary capillary bed is reduced anatomically and also functionally by pulmonary vasoconstriction (Nisell 1950, Harvey and his colleagues, 1951) The blood volume is increased owing to sodium and water retention This is the result of (1) Diminished renal blood flow (Davies, 1951), and probably (2) increased secretion by the adrenal cortex of sodium retaining hormones Blood viscosity rises owing to polycythaemia (Harvey and his colleagues 1951) The cardiac output is often increased, although it may be normal or even low when failure is advanced (Harvey and his colleagues 1951, McMichael, 1952) The reduced pulmonary capillary bed is thus unable to dilate sufficiently to meet the demands of an increased right ventricular output, particularly on exertion, hence recurrent pulmonary hypertension, right ventricular hypertrophy, and right heart failure eventually ensue (Harvey and his colleagues, 1951, Mounsey and his colleagues, 1952)

In cases of cor pulmonale with marked pulmonary hypertension there are

conspicuous changes in the smaller pulmonary arterioles which are identical to those in other forms of pulmonary hypertension, including some cases of mitral stenosis, some forms of congenital heart disease with left to right shunt, and primary pulmonary hypertension (Heath, personal communication) The wall of a small pulmonary arteriole normally consists of a single elastic lamina lying between intima and a thin adventitia (Fig 38a) In pulmonary hypertension an arteriole of similar size shows marked hypertrophy of the wall, a distinct media with definite internal and external elastic laminae, a thickening of the adventitia, and a fibrous proliferation of the intima (Fig 38b) These changes are similar to those found in all other forms of pulmonary hypertension and are probably the result rather than the cause of the hypertension

The cause of heart failure in cor pulmonale is thus gross pulmonary insufficiency due to chronic lung disease In the combined series of cases that came to necropsy reported by Scott and Garvin (1941) and Spain and Handler (1946) emphysema was the dominant lesion in 87 of 110 cases, it was present in all the 50 cases reported by Fulton (1953) and in 74 of the 76 reported by Flint (1954a) Other lesions known to give rise to anoxic heart failure include asthma, bronchiectasis, pneumoconiosis, disseminated bronchial carcinoma, tuberculosis, sarcoidosis, severe kyphoscoliosis, thoracoplasty, and pneumonectomy Possibly in rare cases endarteritis is the primary cause of pulmonary hypertension

With the increasing use of antibiotics for acute respiratory infections many severe bronchitics are now living to a more advanced stage of the disease and it is probable that in the future cor pulmonale will be encountered more frequently in the elderly

Clinical picture

Clinically, in addition to the signs of emphysema, bronchitis and congestive heart failure, patients with cor pulmonale have a characteristic appearance which is caused by the low arterial oxygen saturation and the high arterial carbon-dioxide tension Hypoxia is manifested by central cyanosis so that the warm parts of the body for example the tongue and mucosae, are blue, hypercapnia is manifested by dilated veins, warm skin, throbbing finger tips, bounding pulse, drowsiness depressed respiration and muscle twitching Headache, papilloedema, dilatation of the retinal veins proptosis and chemosis are not uncommon and are also attributed to the marked vascular dilatation caused by hypercapnia

In patients with marked hypercapnia ventilation may be so depressed that orthopnoea is absent The apex beat is usually impalpable owing to widening of the anterior cardiac space b

may be conside

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over the epigastrium, and gallop rhythm is usually heard in the presence of heart failure, often becoming inaudible after recovery Tricuspid incompetence is common Arrhythmias are rare

Thrombosis and embolism

A notable feature in the author's survey was the rarity of venous thrombosis which was encountered in only one of 76 cases, and the absence of pulmonary

embolism The rarity of thrombo embolism in cor pulmonale is probably the result of the high rate of peripheral blood flow, which is more likely to be caused by peripheral vaso dilatation than increased cardiac output, but the chemical factors governing intravascular thrombosis may be influenced directly either by hypoxia hypercapnia Pleural effusion is rare owing to the prevalence of pleural obliteration by adhesions and to the rarity of pulmonary infarction

High incidence of peptic ulceration

Another feature of this survey was the high incidence of peptic ulceration, which was encountered at necropsy in 10 of the 24 cases of cor pulmonale, but in only 3 of the 64 cases with other forms of heart disease In 7 of these 10 cases the

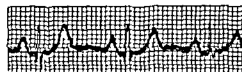


FIG 39 (a) —Electrocardiographic patterns in cor pulmonale Pulmonary P wave —tall, sharp over 2 millimetres in amplitude

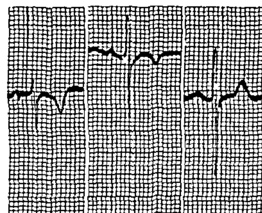


FIG 39 (b) —Electrocardiographic patterns in cor pulmonale T inversion V1 V3 Dominant S V1 V5

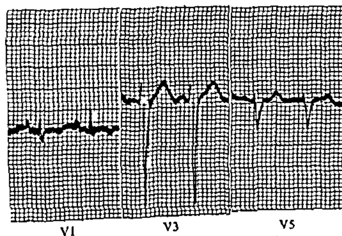


FIG 39 (c) —Electrocardiographic patterns in cor pulmonale Dominant R V1 note dominant S V3 V5

ulcers were multiple and acute and in 2 cases death had been caused by massive haemorrhage, most of these ulcers were symptomless, an observation which was also made by Fulton (1953) The most likely explanation for peptic ulceration in cor pulmonale is a combination of two factors. (1) The gaseous disturbance which is known to increase secretion of gastric juice (Browne and Vineberg 1932) and (2) the acute respiratory infection which probably affects the protective mucus of the stomach

The electrocardiogram

The electrocardiogram in cor pulmonale is not diagnostic but abnormal in about 80 per cent of cases The changes include a tall sharp P wave, clockwise rotation of the heart due to the vertical position in emphysema and often exaggerated by dilation of the right ventricle, and right ventricular hypertrophy (Fig 39)

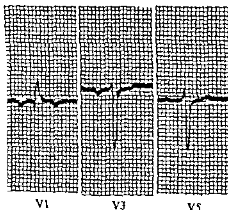


FIG 39 (d)—Electrocardiographic patterns in cor pulmonale qR pattern V1 note there is T inversion V1 dominant S V3 V5



FIG 39 (e)—Electrocardiographic patterns in cor pulmonale RSR pattern V1 prolonged and slurred S V5

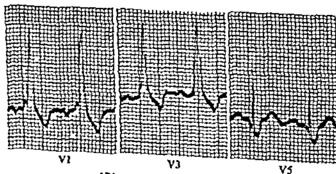
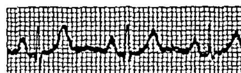


FIG 39 (f)—Electrocardiographic patterns in cor pulmonale Right bundle branch block

embolism The rarity of thrombo-embolism in cor pulmonale is probably the result of the high rate of peripheral blood-flow, which is more likely to be caused by peripheral vaso-dilatation than increased cardiac output, but the chemical factors governing intravascular thrombosis may be influenced directly either by hypoxia hypercapnia Pleural effusion is rare owing to the prevalence of pleural obliteration by adhesions and to the rarity of pulmonary infarction

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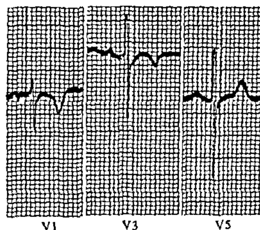


FIG 39 (b) —Electrocardiographic patterns in cor pulmonale T inversion V1 V3 Dominant S V1 V5

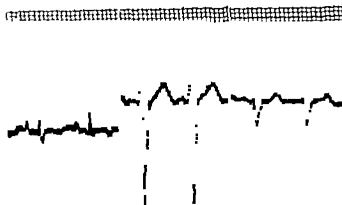


FIG 39 (c) —Electrocardiographic patterns in cor pulmonale Dominant R V1 note dominant S V3 V5

The trachea and bronchi are normally sterile or contain at most a *few naso-*pharyngeal organisms, but in chronic bronchitis there are many bacteria in the bronchi (Stuart-Harris and his colleagues, 1953) These have been divided by May (1953) into (1) Potential pathogens, namely pneumococcus, *Haemophilus influenzae* *Staph aureus*, group A haemolytic streptococcus, and *Bacillus Friedlander*, and (2) organisms of doubtful pathogenicity such as *Streptococcus viridans*, non-haemolytic streptococci, diphtheroid bacilli, *Neisseria catarrhalis*, and *Staph albus* In purulent sputa he always found at least one potential pathogen,

(unpublished) and of Mulder and his colleagues (1952) who draw attention particularly to *H influenzae*

TABLE XXI

BRONCHITIS DEATHS 1950 RATES PER 10 000 PER YEAR

Standard region	*Age 45–64 years*		*Age 65–74 years*	
	M	*F*	*M*	*F*
England and Wales	10 8	2 5	43 0	15 8
Northern	13 2	3 2	40 5	18 7
Tyneside conurbation	18 8	3 3	63 8	28 1
Remainder	11 2	3 2	32 3	15 2
E. and W Riding	13 6	3 3	56 1	18 7
W Yorks conurbation	15 0	4 1	63 3	19 8
Remainder	12 6	2 5	50 8	17 8
North western	16 4	4 7	61 7	26 0
S E Lancs conurbation	20 8	6 2	77 8	34 4
Merseyside conurbation	15 7	3 2	64 6	19 6
Remainder	12 9	4 0	47 1	21 5
North Midland	8 6	2 2	42 8	11 2
Midland	12 8	2 8	45 9	18 3
W Midland conurbation	16 1	3 4	56 2	22 6
Remainder	9 5	2 1	36 6	14 1
Eastern	5 9	1 1	24 4	9 2
London and S E.	9 0	1 8	40 5	12 3
Greater London	9 9	1 9	46 6	13 8
Remainder	5 9	1 3	24 5	8 6
Southern	5 4	1 3	25 7	8 7
South western	6 4	1 4	25 9	10 3
Wales	12 2	2 4	46 9	18 5
Wales I	14 0	2 7	51 5	22 2
Wales II	7 6	1 8	37 1	11 4

(*By courtesy of Mr Goodman Drs Lane and Rampling and the British Medical Journal*)

The

patients suffering from non-specific acute respiratory disease,

AETIOLOGY OF CHRONIC BRONCHITIS

Bronchial hypersensitivity

It would seem that some individuals are especially susceptible to irritation of the broncho-respiratory tract, particularly by infection They react (1) By secreting an excess of mucus which both obstructs the airway of the smaller bronchioles and also probably enhances bacterial invasion (Oswald, 1954), and (2) by true broncho spasm It has been suggested that this hypersensitivity is a form of allergy but it is not fully understood There is a good deal of evidence that susceptibility to bronchitis is to some extent hereditary, Oswald, Harold and Martin (1953), surveying 300 bronchitics and 300 controls, found that 11 4 per cent of the relatives of the bronchitics had chronic bronchitis, compared with only 3 8 per cent of the relatives of the controls

Sex differences

Study of the Registrar General's Reports show a higher death rate for men than women in each of the age groups, the male/female ratio for bronchitis being more than twice that for deaths from all other causes between the ages of 45 and 64 years but only slightly in excess for persons over 65 years The male mortality excess does not, however, reflect its true sex incidence Women seem to have more frequent attacks than men, but they are usually shorter and less severe (Goodman, Lane, and Rampling, 1953)

Infection

The life history of a patient with chronic bronchitis is punctuated repeatedly by infections of the upper respiratory tract The causal virus seems to damage the respiratory epithelium and thus to weaken the defences of the respiratory tract against bacterial invasion Certain severe forms of infection are probably capable of causing irreversible damage to the bronchioles in a previously healthy lung and milder infections can probably cause further damage to the respiratory tract of bronchitics In fatal cases of influenza the necrotizing effect on the trachea and bronchi of the influenza virus when associated with invasion by *Staphylococcus aureus* is well known This type of infection, if less severe, may often be the origin of chronic bronchitis, particularly if the smaller bronchioles are attacked, and may occur at any age

A damaged respiratory epithelium is probably more susceptible than a healthy epithelium to invasion by viruses The adult chronic bronchitic seldom suffers from serious infection of the pharynx or sinuses

Oswald, Harold and Martin (1953), in their study of 1,000 bronchitics, found that 476 regarded the mode of onset of their bronchitis as acute, acute bronchitis in 342, pneumonia in 118, whooping cough in 13 and measles in 3 Associated causes at the time of onset included coryza in 149, influenza in 72, gassing in the 1914–18 war in 27, surgical operations in 13, pleurisy in 7, sinusitis in 6, mental shock in 6 and childbirth in 3 Many thought that a single respiratory infection suddenly converted them from healthy beings into respiratory invalids, and this was particularly so in the elderly

including adenoidal pharyngeal-conjunctival agents, in over 50 per cent of cases

The role of respiratory infections in causing exacerbation of chronic bronchitis is undoubted, but infection associated with severe bronchiolitis may well be the most important factor initiating the disease

Geographical factors

The damp and dirty atmosphere of English cities seems to favour the development of bronchitis The higher death rate from bronchitis in England contrasts with the low rate in the Scandinavian countries, which have a dry atmosphere little polluted by smoke In 1948 the death rate for males per 10,000 from bronchitis was 0 2 in Norway and 0 4 in Sweden, against 17 8 in England and Wales for females the figures were 0 4, 0 2 and 4 5 respectively (*Goodman and his colleagues*, 1953) These workers also found that in England and Wales the highest death rates from bronchitis are experienced in the Northern and Western districts ... the highest rate (20 8 per

methods of certification and to the frequent association with other diseases

Factors influencing range of geographical incidence

The wide range in geographical incidence could be explained by one or more of several different *factors* (1) Atmospheric pollution, (2) humidity, (3) occupational, (4) cross infection due to over-crowding, and (5) malnutrition associated with poverty *in early life* Unfortunately we do not yet know the relative importance of these factors, and, indeed there are probably *many others*

Atmospheric conditions

The two principal atmospheric conditions which are significant in relation to bronchitis are (1) pollution *with dust* and chemicals, and (2) excessive h...

The death rate for ...

that in rural areas ...

and his colleagues ... areas with the worst pollution are also those with lower social and economic standards It is well known that atmospheric pollution may be responsible *for the* deaths of many who suffer from bronchitis

...people indoors and there is *evidence that* in a damp atmosphere the spread of infection is increased Nevertheless the chemical pollution is probably more important The committee set up by the Ministry of Health (*Ministry of Health Reports*, 1952) was unable to lay the blame *squarely* on any one atmospheric

or, "epidemic febrile catarrh" (Huebner and his colleagues, 1954; Hilleman and Werner, 1954; Parrott and his colleagues, 1954; Bell and his colleagues, 1955). Other pneumotropic viruses are presumed to be associated with a rise in titre of cold agglutinins and agglutination of *Streptococcus M.G.* which are sometimes encountered in influenza-like illnesses. The closely related rickettsial bodies found in Q fever may produce similar clinical features. The virus of the common

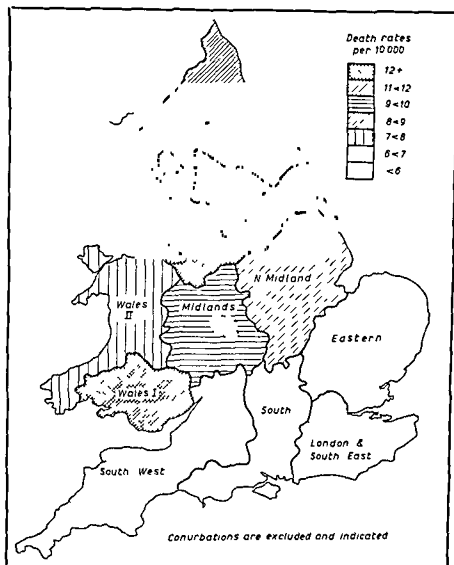


FIG 40—The death rate for bronchitis in England and Wales, 1950 for men aged 45 64 years Geographical distribution (*By courtesy of Mr Goodman, Drs Lane and Rampling and the British Medical Journal*)

cold has so far eluded investigation but it is probably a common cause of exacerbation in chronic bronchitis. In a series of bronchitics in acute exacerbation studied by Flint and his colleagues (unpublished work) and Balducci and his colleagues (personal communication) there was evidence of infection by a known virus,

including adenoidal pharyngeal-conjunctival agents in over 50 per cent of cases

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10 000 men in the 45–64 age group) this is almost four times the rate for the Southern region

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Factors influencing range of geographical incidence

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Atmospheric conditions

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Re ... was unable to lay the blame squarely on any one atmospheric ... Health (Ministry of Health

contaminant, but oxides of sulphur seemed to be the main irritants and the combustion of coal their chief source It was probable that sulphur trioxide, dissolved as sulphuric acid in fog droplets, appreciably reinforced the effects of sulphur dioxide It seemed that the irritant produced anoxia by means of bronchospasm or increased exudation in the respiratory tract, thereby precipitating heart failure in patients with chronic bronchitis and emphysema

The Committee on Air Pollution (1953) estimated the amount of the chief pollutants discharged annually in Great Britain as follows

Smoke – – – – – –	2 1 million tons
Grit – – – – – –	0 6 million tons
Sulphur dioxide – – – –	5 3 million tons
Other acids (nitric and hydrochloric)	0 3 million tons
Carbon monoxide – – – –	24 0 million tons

Although smoke and grit are the most notable features of a polluted atmosphere, it is the invisible oxides of sulphur that cause the most damage and, unfortunately, these tend to escape eradication by filters Pemberton and Goldberg (1954) found a significant correlation between average sulphur dioxide air pollution in the county boroughs of England and Wales and the mortality rates for bronchitis in men aged 45 and over, but the association between air pollution with solid matter and bronchitis mortality rates was much less consistent

The Beaver Committee (Report of the Committee on Air Pollution, 1954) made the following recommendations Increased provision of smokeless fuel for domestic grates, introduction of appliances for economical burning of these fuels, introduction of modern plant, better methods of stoking and the wider use of gas and electricity in industry, establishment of more smokeless zones and smoke control areas (in which the use of bituminous coal for domestic purposes would be restricted), and more effective legislation against the emission of black smoke Unfortunately these measures, although desirable, would not reduce the more dangerous sulphur content of the atmosphere, and means would have to be found for more effective cleaning of coal at the pithead and for the utilization of other fuels The problem may ultimately be solved by the wide use of atomic power

Occupational and other social factors

Study of the Registrar General's Reports shows that the standardized mortality rate for bronchitis in social class V (unskilled workers) is five times that in class I (professional and managerial) This is probably due to a combination of factors which are, among others (1) Crowded homes, with consequent greater ease of infection particularly in the young, when the seeds of the disease are often sown, (2) poverty and malnutrition, and (3) the greater exposure of the poor to inhalation of dust both from a polluted atmosphere and from their environment at work

Occupational statistics

According to Table XXII, which has been prepared from the Registrar General's statistics by Goodman, Lane and Rampling (1953) the "dusty" trades are high on the list Predominantly outdoor work does not seem to have an adverse effect Gardeners, agricultural labourers, railway porters and builders' labourers are all below their social class averages These figures, however, are based on the occupation

TABLE XXII

OCCUPATIONAL DISTRIBUTION OF BRONCHITIS DEATHS, 1930–32 MALES AGED 20–65
(ALL MALES=100)

Social Class III	Ratio	*Social Class IV*	Ratio	*Social Class V*	Ratio
Coal hewers and getters	170	Metal grinders – –	222	Costermongers news-paper sellers – –	230
Metal moulders and diecasters – –	169	Road transport—horse drivers – – –	205	Messengers porters, etc	203
Furnacemen rollers etc	163	Iron and steel foundry furnacemen and labourers – –	179	Water transport, dock labourers – –	199
Masons stonecutters –	147	Coal workers, above ground – – –	172	General labourers, etc –	187
Cotton spinners – –	132	Coal—others below ground – – –	143	General unskilled workers etc – –	176
Warehousemen storekeepers – – –	118	Textile dyers – –	140		
Salesmen of meat greens, etc – –	117	Coal—conveying to shaft	135		
Paper hangers painters etc – – –	111	Sawyers and wood turners – – –	128		
Boiler makers etc –	108	Coal workers below ground – – –	126		
Hairdressers etc –	107				
Boot factory workers (skilled) – – –	103				
Boot makers and repairers – – –	102				
Tailors etc – –	100				
Cotton weavers – –	97				
Bricklayers – – –	94				
Smiths and skilled forge workers – –	92				
Total of all in Social Class III – – –	91	*Total of all in Social Class IV* – – –	124	*Total of all in Social Class V* – – –	156
Stationary engine drivers	89	Fitters labourers, etc	123	Builders' labourers, etc	133
Fitters mechanics etc –	81	Metal machinists – –	111	Railway porters – –	117
Postmen and sorters –	80	Coal workers—road ways – – –	102	Other workers, navvies in building – –	74
Domestic servants (in doors) –	73	Boiler firemen and stokers – – –	93	Agricultural labourers –	52
Typists and other clerks	71	Platelayers – – –	90		
Bakers and pastry-cooks	67				
Carpenters – –	65				
Road transport—motor drivers – –	64				
Railway engine drivers etc – –	60				
Civil Service typists and clerks –	54				
Gardeners nurserymen etc –	51				

(*By courtesy of Mr Goodman Drs Lane and Rampling and the British Medical Journal*)

as given on the death certificate, which may not have been the predominant occupation of the individual's working life Moreover, the existence of chronic bronchitis may have driven men from work involving heavy physical labour or the inhalation of a lot of dust

From the author's survey of 300 cases of heart failure admitted to a General Hospital in Sheffield (Flint, 1954a) it was apparent that among the working male population cor pulmonale was the commonest form of heart failure In 159 males

contaminant, but oxides of sulphur seemed to be the main irritants and the combustion of coal their chief source It was probable that sulphur trioxide, dissolved as sulphuric acid in fog droplets, appreciably reinforced the effects of sulphur dioxide It seemed that the irritant produced anoxia by means of bronchospasm or increased exudation in the respiratory tract, thereby precipitating heart failure in patients with chronic bronchitis and emphysema

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Occupational statistics

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toxic effects are seldom encountered if the dose is not too large, that is 250 milligrams of aureomycin, four times a day but it is usually wise to give a prolonged course for 10–20 days or relapse is frequent Fulminant staphylococcal enteritis and fungus infections of the lung are the most dangerous risks of oral antibiotic

useless in the treatment of severe bronchial infections

Although the acute attack usually responds to treatment with one of the broad spectrum antibiotics, relapse is invariable with the next family cold Attempts to prevent relapse have been made by continuing the antibiotic therapy for long periods although toxic effects are encountered in a proportion of patients so treated they are seldom serious except when the dosage is high McVay and Sprunt (1953) gave 250 milligrams of aureomycin twice daily to 21 patients, 10 of whom received the drug for more than a year, in only one of these had the drug to be discontinued The incidence of respiratory infections in this group of patients was compared with that in 9 control patients whose respiratory state was considered to be similar The frequency of infections was diminished in 17 (81 per cent) of the treated patients and in 2 (22 per cent) of the
of the treated patients, compared
admission to hospital during the p
treated 34 severe chronic bronchitics with prolonged courses of oxytetracycline (terramycin) In certain advanced cases this treatment was continued for periods ranging from six to thirty months the maintenance dose ranged from 1

respiratory infection but it is worth a trial in advanced cases Vitamin B complex should be given regularly For long term treatment, chloramphenicol should be avoided because of the danger of marrow aplasia The newer drug tetracycline, is probably as effective as its
mycin and aureomycin t
stantiated (Report from t

The cough

Death from
emphy
sputum
successful suppression of the cough is likely to prove dangerous Sedative cough medicines which usually contain heroin or morphine are only indicated when the cough is

there were 64 cases of cor pulmonale most of whom were men aged 50–70 years. cor pulmonale was nearly twice as common as any other single cause of heart failure 66 per cent had been engaged in the heavy iron and steel industry, and most of them, whether as grinders, fettlers, rollers or furnacemen, had been exposed to excessive inhalation of various dusts including silica, or to rapid changes of temperature in the foundry or rolling mill The findings in this survey also suggest that heavy manual work increases the likelihood of heart failure Until the disease was far advanced none had followed a sedentary occupation, 88 per cent had been doing heavy manual work, compared with 52 per cent of patients with other forms of heart failure, and 50 per cent were actually working up to the onset of their present illness (two-thirds of these were doing a heavy job), compared with only 19 per cent of the other patients, of the 23 patients with cor pulmonale who died 13 were working up to the onset of their terminal illness The view that in chronic bronchitis heavy manual work increases the likelihood of heart failure was also expressed by Donald (1953), and it would help to explain why cor pulmonale is so rare in women, even those crippled by asthma and emphysema

Tobacco

Tobacco seems to be an aggravating factor in chronic bronchitis The "smoker's cough" is well known among cigarette smokers, and Whitfield and his colleagues (1951) have shown that smoking reduces the ventilatory capacity Oswald and his colleagues (1953) found a higher incidence of smoking in 300 bronchitics than in controls of similar age and sex distribution, the figure being 91 0 per cent and 79 3 per cent respectively A high incidence of heavy cigarette smoking was also found in the patients with cor pulmonale reported by the author (Flint, 1954a)

TREATMENT

With existing knowledge the effective treatment of chronic bronchitis resolves itself into the treatment of the acute infective episodes

The infection

Although in most cases a virus is believed to initiate the infection, treatment can only be directed against the bacterial invaders, for no chemotherapeutic agent or antibiotic has been isolated which is effective against these viruses

In lobar pneumonia the commonest pathogen is the pneumococcus 73 per cent of cases in the Medical Research Council Survey (1951) were pneumococcal in origin In purulent bronchial infections the sputum yields a mixed bacterial flora closely resembling that of the nasopharynx, of which pneumococci and *H influenzae* constitute the commonest pathogenic species (Stuart-Harris and his colleagues, 1953, May, 1953, Flint and his colleagues, unpublished work) Therefore penicillin is the treatment of choice for most forms of pneumonia but it is not so effective in bronchitis The wide spectrum antibiotics (tetracycline, oxytetracycline (terramycin), chlortetracycline (aureomycin), and chloramphenicol) are usually more effective than penicillin in those infections due partly to *H influenzae*, aureomycin is one of the best (Flint and his colleagues, unpublished work, Gabrielsen and his colleagues, 1954) Serious gastro intestinal

intake, the tube should be of small bore and the patient propped up on pillows to prevent oesophageal reflux. In the severely dehydrated patient feeding can be supplemented by half normal saline with 2–6 grammes of potassium chloride daily Intravenous therapy is contra-indicated

In contrast to the state of over-hydration in heart failure, a diminished adreno-cortical response to disease or "stress" might explain why dehydration is relatively common in the elderly, but the failure to drink enough because of general fatigue, apathy and neglect is probably the more usual explanation

Heart failure

In the event of heart failure the usual measures should be employed including water and salt depletion, mersalyl and digitalis Great care should be taken not to over-treat mild water retention as a dangerous state of dehydration may easily ensue In all forms of chronic heart failure, including cor pulmonale, a low salt regime is likely to be helpful

Other measures

A close watch should be kept for complications, especially heart failure, venous thrombosis, constipation and, particularly in old men receiving mersalyl, urinary retention Spontaneous pneumothorax is a rare but elusive complication of emphysema

Except in the case of peripheral circulatory failure nothing is gained by keeping old people in bed In general they should be persuaded to get up in a chair for short periods each day even at the height of their illness Very few old people can risk complete bed rest, especially those who are seriously ill Change of posture ...

... is the best form of rehabilitation

CONCLUSION

The introduction of effective measures against atmospheric pollution together with the great advances in the treatment of ...
and lungs will in the future undo
these measures will be slow in mat
...
n greater problem
...eans of preventing
way ultimately to
... of serious bronchitis At the moment specific therapy must be directed to the secondary bacterial invasion as the viruses involved are resistant to antibiotic therapy

In addition to a better understanding of the various virus and bacterial agents, we need to know much more about the biological process of defence ...
infection Increasing ...
of the adrenal corte...
of respiratory and

chronic bronchitics, failed to show that it was influenced at all by any of a large number of expectorants used in conventional doses.

Various methods which have been employed from time to time to reduce the viscosity of the sputum and to stimulate expectoration, include various inhalations such as steam, menthol and aerosols of various detergents or of trypsin and allied substances They are usually rather cumbersome and disliked by the patient and none of them are satisfactory unless maintained for long periods Probably the most effective methods of stimulating the cough are frequent change of posture, chest thumping and early ambulation The more ill the patient the more important is it that he should be got out of bed as soon as possible Postural drainage is helpful in the quiescent phase if there is much sputum In drowsy patients with cor pulmonale, bronchoscopic aspiration can be a life-saving measure.

Antispasmodics are occasionally helpful but they are not as effective in bronchitis as in uncomplicated asthma When bronchospasm is severe intravenous aminophylline or hypodermic adrenaline will be found most effective, but isoprenaline by inhalation or the sublingual route and ephedrine or a stramonium preparation will usually help the milder case Corticotrophin (ACTH) or cortisone, although effective in some cases of status asthmaticus, are seldom useful in bronchitis, and are contra-indicated in patients with heart failure

Oxygen

Oxygen is useful in some cases of severe bronchitis but should be given in a tent or by nasopharyngeal catheter, a mask is not tolerated by bronchitics

In patients with severe hypoxia and hypercapnia, oxygen may be harmful because of respiratory depression In cor pulmonale prolonged hypercapnia depresses the respiratory centre which no longer responds to stimulation by carbon dioxide In these cases the only stimulus to respiration is oxygen lack, and if this stimulus is removed by giving oxygen, ventilation becomes further depressed, with the result that the patient's colour improves but coma ensues owing to a deepening carbon dioxide narcosis (Davies and Mackinnon, 1949) Oxygen should therefore be withheld from patients with depressed ventilation unless an artificial respirator is used

Fluid and electrolyte depletion

Severe dehydration is an occasional accompaniment of respiratory infection, particularly in the elderly This is usually seen in persons whose nursing has been neglected so that adequate fluid and electrolyte requirements have not been met In association with chronical renal disease dehydration is most dangerous, for a high output of urine is necessary to prevent renal failure The author has occasionally seen a severe state of dehydration with very low serum sodium and potassium

mistaken for pyloric or intestinal obstruction

Usually an adequate intake of fluid, calories and electrolytes can be achieved by a daily intake of 4–5 pints of milk with glucose and fresh fruit drinks, but in severe dehydration tubal feeding is sometimes the best means of ensuring an adequate

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methods of improving the natural defence mechanism rather than by an endless search for new antibiotics We need more knowledge of these biological processes, including a better understanding of the influence of genetics on the defences of the respiratory tract and the peculiar liability of some individuals to bronchospasm and excessive secretion of mucus A better understanding of these matters is probably more important even than the abolition of atmospheric pollution

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... of the

trauma purpura may occur Tattersa... and ...
senile purpura that there is in addition to extravasated blood severe degenerative change in the collagen It is reasonable to postulate that some of the changes ...

proliferation of the epidermis, progressive development of the rete pegs and papillae and in addition new formation of elastic fibrils and increased vascularization of the cutis took place especially after the application of oestrogens Oestrogenically mature *beta-oestradiol* and the androgenically weak 17 *methylandrostradiol* showed comparable effects Giving the substances by mouth did not have the same effect



FIG 41 —*Post menopausal or senile skin tags* on the neck of a woman

Vitamins in skin changes

Vitamins appear to play little part in the sk...
Camph...

... to disappear and the degree of follicular hyperkeratosis ... the skin to to diminish Biopsy of the area showed thickening and increased granulation in the

CHAPTER 8

SKIN CONDITIONS IN THE ELDERLY

H R VICKERS and I B SNEDDON

CHANGES IN THE SKIN WITH AGE

THE AGE of a person is usually judged by his appearance and this is an admission of the fact that throughout life the skin, in common with all other organs, gradually undergoes well-recognized changes by means of which age can usually be assessed with a reasonable degree of accuracy

On analysis these changes are made up of many parts, the surface texture, the greasiness of the skin, the colour, the amount of wrinkling, the laxity and presence or absence of atrophy, but perhaps the greatest single factor on which age guessing is based is the colour and amount of the hair These changes of appearance in the skin are so well known that it is almost superfluous to mention them The chronological stages have been excellently listed by Traub and Spoor (1953)

Differences of appearance between youth and old age

One would expect that the great differences in appearance between the skin of an adolescent and the skin of a senile bedridden ancient would also be seen on *microscopical examination, but such is not the case Extensive histological studies* on changes of the normal skin in different age groups have been carried out by Ejiri (1936, 1937), Hill and Montgomery (1940) and Strobel (1948) Ejiri studied exposed skin whereas for the other two papers only covered skin from similar areas was examined The only marked change seen in the epidermis in old age is some atrophy without degeneration giving rise to flattening of the rete pegs Ejiri noted plugging of hair follicles and sweat ducts in old age but this was not seen by the others and may therefore be a change occurring only in the exposed areas In the cutis there was no histological change in the sebaceous and sweat glands and even the blood vessels, muscles nerves and fat in the skin of the old person were microscopically the same as in the young The only differences seen by all the workers was in the collagen which in age becomes atrophic, the collagen fibres become thinner, rarefied and more elongated, losing their former wavy appearance and lying in parallel bundles Whether or not further degeneration takes place with the formation, with the elastic tissue, of collacin is not yet proven The demonstration of these changes is dependent upon differential staining pro- ... the changes described in age, namely ... alin degeneration of the elastic fibre, ... n parts of the body normally covered the only change found is stretching of the fibres Thus the factors responsible for the ageing of skin must be due to alteration of function and not to anatomical

also used bath salts Many of these patients imagine that the irritation is due to some fell infection and add various proprietary and much advertised antiseptics to the bath water which only act as further aggravating factors

Treatment

... the natural grease of the skin as much as ... All soaps are ... more alkaline the soap the worse it is Similarly detergents, being degreasers, are harmful As one would imagine, ointments are tolerated much better than lotions and ung aquosum containing ½ per cent crude coal tar, or Lassar's paste containing 2 per cent crude coal tar applied sparingly to the areas as necessary, are very effective In our hands, crude coal tar is a much better antipruritic than most of the other commonly used agents Ointments containing benzocaine and its derivatives should never be used because of the dangers of sensitizing the patient Some cases respond well to various antihistamine-containing creams The long acting antihistamines, such as promethazine hydrochloride, 50 milligrams every night, are useful probably because of their sedative action Sodium amylobarbitone can be given in doses depending on the general state of the patient If the pruritus is localized to a relatively small area, fractional doses of x ray are of great assistance It is always important to reassure the patient that the condition is not infectious and that it is not due to dietetic irregularities

Psychogenic pruritus

In addition to the ... whom the ... themselves ... difficult to ... It is almost bordering on the cases of parasitophobia, and as a rule little can be done for this type of patient Psychotherapy is of no avail but they are helped, as a rule, by heavy sedation

Senile dermatitis

Although most forms of dermatitis may occur at any age, there is a variety seen much more commonly in the old which would appear to be associated with the diminution of grease in the skin It is much more common in men than women and usually starts on the anterior aspect of the lower legs It is well known that the blood supply and the sebaceous secretion of the skin of the lower legs is poorer than in any other part of the body, for instance ichthyosis is always most marked on the lower legs They are also poorer in people who have a naturally dry skin and ...

... and other insults, dermatitis is produced As the inflammatory process in the skin becomes established ...

Also ...

secc ...

... other parts of the body These

stratum granulosum. Despite these experimental results the use of vitamins and hormones is of little practical value

Greying of hair

The greying of hair is not fully understood although Frost (1948) states that it is due to loss of pigment cells and in experimental animals it can be produced by various severe nutritional deficiencies which, however, could not explain the common occurrence of grey hair in humans There is no doubt that greying of the hair is an inherited anomaly There is still a good deal of controversy about whether or not hair can turn grey almost overnight Barahal (1940) is of the opinion that there are several well-authenticated cases and in these the grey colour may be due to sudden release of air bubbles in the hair shaft

Baldness

On the other hand, baldness is directly associated with hormonal imbalance The loss of hair from the frontal areas and vertex of the scalp is almost physiological in men and is often associated with increased growth of body hair and a deep voice This loss of hair is a feature of androgen domination and confirmation of this is given by the infrequency of the male type of baldness in women and in male castrates After the menopause and with increasing age, loss of hair of the male type in women is not uncommon The hair becomes thin and sparse on most of the scalp and bald areas appear first on the vertex and then gradually spread forward towards the forehead No treatment is of any avail

Self-renewal of skin

It is probably because the skin is constantly renewing itself that histological changes with age are not seen as markedly as in other organs, but in spite of this, various dermatoses are seen either solely in old age or occurring much more commonly in the aged It is of note that dermatological manifestations of allergy and epidermal sensitization are much less common in old age and this is also probably associated with alteration in the hormone balance

DERMATOSES PECULIAR TO OLD AGE

Senile pruritus

Intractable intense generalized irritation occurs commonly in old age Irritation may be due to infestation or to various internal diseases such as diabetes, chronic nephritis, malignant disease and the reticuloses, but in the largest group of cases, no such cause is present The irritation usually affects the whole body, is most marked on the legs and trunk and is usually very apparent on undressing It is more common in winter than summer It is invariably accompanied by dryness of the skin and, in more severe cases, the skin may be covered by very fine scaling The condition is aggravated by washing and is probably due to the changes in the epidermis caused by gradual diminution of sebaceous secretion This loss of the natural grease on the skin surface is accentuated by washing and the most severe case of senile pruritus we have seen was that of an old lady, 80 years of age who bathed twice a day, not only did she immerse herself in very hot water, but she

produce dermatitis This is seen particularly in elderly women who continue to work as charwomen the alkaline solutions used in scrubbing giving rise to traumatic dermatit s of the hands and forearms occasionally men who have for many years carried out work in dusty surroundings may develop dermatitis in old age

Pemph go d

Wh mster 1950) it became possible to note cl nica d ffere ce b
and the d sease wh ch had previously been grouped with it and wh ch is now known as pemphigoid (Lever 1953 Rook and Waddington 1953 Church 1953) Most pat ents with pemphigoid are over 70 years of age in a recent series of 11 cases seen in our Department the average age was 76 years



Fig 4 The erup on of pemph go d show ng the bullae and the assoc ated dusky erythema

D agno is an l cl n cal p cture

The illness commonly starts w th a non specif c rash on the limbs which may be urt car al or occas onally eczematous When urt carial this stage lasts one to three weeks before bulla format on occurs when eczematous blisters may not appear for 2 to 3 months As Rook and Waddington (1953) have po nted out some cases start with local zed groups of bl sters which may persist for several weeks and present a d agnost c problem to those unfam liar with the subsequent

secondary areas are usually markedly symmetrical and the sites affected are the thighs, buttocks, lower back, forearms, shoulder area and face Often the condition is materially aggravated by injudicious self-treatment and bathing

Treatment

In most cases the dermatitis remains at the stage of erythema and scaling but in some there is vesiculation, exudation, crusting and secondary infection Treatment depends on the stage of dermatitis In the milder forms, treatment similar to that used in senile pruritus is satisfactory, namely drastic restriction of washing, the application of Lassar's paste containing up to 2 per cent crude coal tar and superficial x-irradiation In the more severe cases with weeping and secondary infection, it is necessary at first to use lotions If the lesions are secondarily infected wet dressings of ½ per cent silver nitrate solution, solution of aluminium acetate (Burrow's solution) and eusol are effective Local application of an antibiotic cream sometimes clears the condition surprisingly quickly but these should be used only with bacteriological control and never for more than a few days If they are going to be effective, they will clear the condition in a few days and to persist in their use in the absence of marked improvement may result in producing dermatitis from the antibiotic or a strain of organism resistant to that substance

Removal of crusts—A most effective preparation for the removal of crusts is the application of an ointment consisting of equal parts emplastrum plumbi and paraffin molle flav This is spread thickly on linen and applied to the crusted area for 12 hours, repeating the application every 12 hours as necessary

Weeping lesions—In the absence of secondary infection, the weeping lesions should be treated with one of the "shake lotions", calamine lotion or the lotion preferred by us, which is as follows

Zinc oxide	–	–	–	1 ounce
Fuller s earth	–	–	–	1 ounce
Glycerine	–	–	–	4 drachms
Water to	–	–	–	12 ounces

As the condition subsides, tar can be incorporated into either of these, either up to 5 per cent liquor picis carbonis or up to 2 per cent crude coal tar. If crude coal tar is used, it should be mixed into the glycerine before adding the water and solids Later as the condition of the skin improves, Lassar's paste can be used Water must not be used to clean the skin, instead the area can be cleaned either with the lotion which is being used or with liquid paraffin

Dietetic measures have no place in the therapy of this type of dermatitis but occasionally a pellagra-like dermatitis is seen when there is a deficiency of vitamin B and this must be treated appropriately When dermatitis of this type characterized by erythematous scaling of the lower legs occurs in women, it is often associated with some degree of anaemia and may be a manifestation of vitamin B_{12} deficiency

Occupational dermatitis

Although this occurs in any age group, when old people continue to work, owing to the diminution of skin resistance, contact with irritants is more liable to

produce dermatitis This is seen particularly in elderly women who continue to work as charwomen, the alkaline solutions used in scrubbing giving rise to traumatic dermatitis of the hands and forearms, occasionally men who have for many years carried out work in dusty surroundings may develop dermatitis in old age

Pemphigoid

Pemphigoid is one of the most distressing skin diseases which are confined to elderly people (Fig 42) It has only been possible to differentiate this condition from pemphigus vulgaris since Civatte (1943) observed histological differences between the bullae of pemphigus and those which occurred in other blistering eruptions Once Civatte's histological method of diagnosis was confirmed (Rook and Whimster, 1950), it became possible to note clinical differences between pemphigus and the disease which had previously been grouped with it and which is now known as pemphigoid (Lever, 1953, Rook and Waddington 1953 Church, 1953) Most patients with pemphigoid are over 70 years of age, in a recent series of 33 cases seen in our Department, the average age was 76 years



Fig 42.—The eruption of pemphigoid showing the bullae and the associated dusky erythema

Diagnosis and clinical picture

The illness commonly starts with a non specific rash on the limbs which may be urticarial or occasionally eczematous When urticarial, this stage lasts one to three weeks before bulla formation occurs when eczematous, blisters may not appear for 2 to 3 months As Rook and Wadd[illegible]
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course of the disease These "primary lesions" often occur at the site of some existing skin injury such as gravitational ulcer. We have also seen the first blisters on the scar of a cicatricial alopecia, the scar of burns and more than once round the umbilicus If the patient is fortunate and survives the generalization of the rash, the primary area often continues to blister when the rest of the skin has healed

Sudden generalization of the true eruption of pemphigoid follows these prodromal eruptions and most of the body is affected within a week Severe irritation may precede the eruption At first, raised areas of dusky erythema appear bearing an ominous resemblance in tint to *post-mortem* livedo *Blisters soon follow on both* erythematous and apparently normal skin and sometimes form a gyrate pattern at the edges of the zones of erythema The blisters are tense and dome-shaped and vary in size from vesicles to large bullae from 2 to 3 inches across Their contents usually consist of clear serum but are occasionally bloodstained Though large, the blisters are remarkably tough and may remain intact for several days and occasionally the serum coagulates In some blisters the serum is absorbed so that the epidermis settles back in place like a skin graft, but the majority rupture and form erosions which crust and heal with remarkable speed leaving a pigmented stain Mucosal lesions consisting of blisters and discrete erosions are usually confined to the oral mucosa which is affected in more than half the cases but as a rule not until after the generalized eruption has appeared The mouth lesions are rarely severe and, like the erosions on the skin, heal fairly readily. *The illness is usually accompanied by a leucocytosis with a variable increase* in the eosinophil count which is of little diagnostic significance A fever is unusual but this may be due to the tendency for the aged to remain apyrexial in what would be a febrile illness in a younger subject The eruption of blisters and erythematous areas is cyclical and the interval between fresh crops of blisters varies from a few days to two or three weeks The periods of quiescence may therefore raise false hopes of therapeutic success The course of the disease is very variable, some cases undergo spontaneous remission whilst others appear to remit as a result of treatment A fatal termination is not uncommon, the cause of death being bronchopneumonia in most cases A complication which predisposes to this is generalized oedema resulting from a loss of plasma proteins through the eroded skin

Confirming diagnosis of pemphigoid

Confirmation of the diagnosis of pemphigoid can be obtained by biopsy of one of the early small blisters The bulla of pemphigoid is sub epidermal, the entire epidermis being torn off the papillary bodies and lifted into a dome by the outpouring of serum which accumulates in the cavity This contrasts with the finding in pemphigus vulgaris in which the bulla is intra-epidermal and the epidermal cells undergo a degenerative process called acantholysis

Histological differentiation between pemphigus and pemphigoid

The infallibility of the histological differentiation between pemphigus and pemphigoid *has not been accepted by all dermatologists* Hellier (1954) has reported one case of pemphigus vulgaris in whom sub-epidermal bullae and intra-epidermal bullae with acantholysis were found in different phases of the disease.

while Prakken and Woerdmann (1955) in two cases found both types of bulla present simultaneously

Treatment

It is our practice to start treatment with intramuscular administration of ACTH gel, 50 milligrams on the first day and then 20 milligrams twice daily On this dosage in all but 2 of 11 cases, new blisters ceased and the dose could be reduced within a few days to 20 milligrams daily and the patient discharged from hospital on a maintenance dose of 20 milligrams on alternate days. One feature which we have noted on several occasions is that if the dose is lowered too much and new blisters appear again, then a high dose of ACTH may be necessary to control the disease once more (new blisters may be forecast by premonitory plaques of erythema)

An antibiotic is given to prevent the possibility of lung and skin infection whilst on the high dose of ACTH (usually aureomycin is used since it may help also to control the blisters) The [illegible]

[illegible] therapy

On the larger doses of ACTH, a low salt diet and added potassium (1 gramme three times a day) are given to prevent electrolyte imbalance but these are stopped when the low maintenance dose is reached Where possible the patient should be taught to give his own injections before discharged home but in the case of some of the very old people it is necessary to train a relative or request the help of the district nurse.

SKIN DISEASES WHICH MAY BE A PROBLEM IN OLD AGE

In many elderly people, particularly those who are over-weight, irritation and painful fissures occur in parts of the body where skin surfaces are in close apposition, for example the axillae, the submammary folds, the groins, perineum and natal cleft In order to achieve success in treatment it is essential to determine the cause as there are several conditions which affect those areas

Simple maceration or sweat intertrigo

The most common cause of itching and fissuring beneath the [illegible]
groins [illegible]
the [illegible]
of th[illegible]
elderl[illegible]
be a [illegible]

Clinical appearance

The clinical appearance is of an erythematous and slightly pigmented shiny zone present on contiguous areas on either side of the body fold with a shallow fissure in the fold itself

course of the disease These "primary lesions" often occur at the site of some existing skin injury such as gravitational ulcer. We have also seen the first blisters on the scar of a cicatricial alopecia, the scar of burns and more than once round the umbilicus If the patient is fortunate and survives the generalization of the rash, the primary area often continues to blister when the rest of the skin has healed

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body fold There is often a bluish almost milky looking appearance superimposed on the erythema There are never the outlying vesicles which are seen in monilia infection and there may be lesions of psoriasis elsewhere on the body which will assist in diagnosis

Treatment

The most effective local application is the following:

Hydrarg ammon	–	–	10 grains
Liq picis carb –	–	–	30 minims
Paraffin molle –	–	–	to 1 ounce

The stronger applications such as dithranol, used in psoriasis elsewhere on the body should not be used

A persistent fissure in the natal cleft is often troublesome and this can be healed by painting the fissure daily with tinct benz co and collodion equal parts, or with crude coal tar Superficial x ray therapy 100 roentgen units repeated 2 or 3 times at weekly or fortnightly intervals is effective in relieving the pruritus

Seborrhoeic dermatitis

The body folds and umbilicus are often affected by seborrhoeic dermatitis which is not uncommon in elderly men It is sometimes difficult to differentiate seborrhoeic dermatitis from psoriasis but a confluent scaly dandruff together with greasy circinate scaly lesions on the sternal and interscapular areas and involvement of the face will usually be present in seborrhoeic dermatitis

The lesions in the clefts have a yellowish brown hue and there is often an associated staphylococcal folliculitis of the pubic and axillary hair

Treatment

Local treatment with the following ointment is usually effective:

Camphor	–	–	15 grains
Acid carbolic –	–	–	15 grains
Sulphur –	–	–	15 grains
Acid salicyl –	–	–	10 grains
Paraffin molle	–	–	to 1 ounce

The pyogenic infection can be controlled by Vioform ointment or in the most resistant cases by aureomycin (3 per cent) ointment

Vulval leukoplakia and atrophy

There has been much confusion of terminology in lesions of the vulva and considerable difference of [illegible] the criteria f[illegible] change whic[illegible] reaching psychological sequelae it is vitally important that it should be distinguished from the other [illegible] in a skin clin[illegible] rarity is due to[illegible] straight to the gynaecologist, even so, there are a number of more common [illegible]

Treatment

Treatment consists of attempts to increase ventilation of the folds by weight reduction and the wearing of brassiere and corsets Cleansing the skin with 1 per cent cetrimide followed by adequate drying and a dusting powder of 5 per cent boric acid in talc will allay the irritation but this regime will have to be continued in order to prevent recurrence

Monilial intertrigo

Clinical appearance

If on examination there is a vivid purplish red intertriginous eruption spreading from the groins and extending along the perineum and into the natal cleft, infection with *Candida albicans* is a possibility Further investigation will show that there is also a vulvitis and vaginitis in the female and possibly a balanitis in the male A characteristic feature of monilial intertrigo is that at the edge of the confluent erythematous zone there are usually scattered separate vesicopustules with a milky appearance Similar lesions may be found in the umbilicus, under the breasts, and the axillae

Although it is possible to find *Candida albicans* on culture of these pustules and from vaginal swabs, it is not easy to demonstrate mycelium in skin scrapings The occurrence of monilia intertrigo should make one suspicious of an underlying glycosuria which may be present in the elderly arteriosclerotic without the symptoms of diabetes Nevertheless, a considerable number of elderly people develop monilial intertrigo without a concomitant glycosuria Possibly some alteration in the pH of the skin with old age allows such infections, which are very rare in younger people, to flourish

Treatment

Although somewhat painful on first application and undoubtedly messy because of its colour, Castellani's basic fuchsin paint is the most effective remedy It should be applied with a camel hair brush and allowed to dry The paint should be applied to the whole affected area including the vagina Relief of itching and soreness occurs rapidly After treatment for from 7 10 days when the infection should be subsiding, the treatment can be changed to boric acid lotion which, though not so effective, is more pleasant to use A dusting powder containing 10 per cent sodium propionate can be used as a prophylactic to prevent recurrence If an associated diabetes has been found it should of course, be controlled but local applications, even though the glycosuria persists, can usually keep the monilia infection at bay

Psoriasis

Psoriasis in the elderly often spares its more usual sites on the extensor surfaces of the limbs and affects mainly the body folds particularly the groins and natal cleft. When psoriasis does occur on the vulva and perineum it gives rise to intense pruritus Clinically it resembles monilial intertrigo very closely and even to the dermatologist the distinction between the two may be difficult It appears as a confluent red shiny eruption which affects mirror image areas on either side of a

superimposed on a pre existing disorder In this latter event the diagnosis is difficult and sometimes impossible without continued observation and histological examination It is, however, our belief that it is preferable to observe a case for some months and even carry out several vulval biopsies than to carry out needless vulvectomy The leukoplakic patches do vary considerably in their extent in the same patient when observed over a period of several months and what appears to be an irreversible change may involute and clear spontaneously If there is evidence of increasing induration and microscopic changes of increasing epidermal hyperplasia, then surgery is indicated

Treatment

Lichen simplex of the vulva—This requires the same method of approach as lichen simplex elsewhere Sedation, superficial x-ray therapy and local applications of bland antipruritics, and in the severe cases, the use of hydrocortisone ointment are usually effective in relieving the symptoms Any underlying cause of emotional tension should, if possible, be dealt with in order to prevent relapse

Lichen sclerosis—The symptoms of lichen sclerosis which are mainly due to superficial sepsis and painful fissures can be ameliorated by the use of simple emollients such as ung aquosum or one of the proprietary water repellent barrier creams These cases should however, be kept under regular observation as leukoplakia and malignant change may occur

Senile vulval atrophy—The senile vulval atrophy does not call for treatment since it is usually symptomless

We have not ourselves been impressed with either internal or local ovarian hormone therapy in the control of these conditions Once a diagnosis of true and progressive leukoplakia has been confirmed then vulvectomy is the treatment of choice since cancer follows in 50 per cent of cases

Leg ulcers

Chronic leg ulcers of the type known as varicose stasis or gra- [illegible]
middle age but owing to their chronicity [illegible]
aged Anning (1954), in an investigation c [illegible]
696 women of whom 275 (40 per cent) we [illegible]
cause disability in several ways They give rise to pain which may be severe enough to cause loss of sleep many of our elderly patients paradoxically say that the pain is worse in bed and therefore, prefer to sit up in a chair at night, thus increasing the [illegible] wing to long continued ulcer- [illegible] tissue becomes fibrotic and [illegible] of the ankle joint becomes impossible any attempt to move the joint causes pain The joints may also become fixed by many weeks of bed rest in an attempt to heal the ulcers Lastly, the continued presence of an extensive ulcer with a foul smelling discharge becomes a burden to the patients and those who live with them

Aetiology

In recent years largely owing to the writings of Bisgaard (1948) and Anning (1952 1954) our knowledge of the aetiology of leg ulcers has grown It is now

conditions which are mistaken for leukoplakia We have seen a number of patients who have been needlessly treated by vulvectomy for conditions such as psoriasis and lichen sclerosis

Pathological conditions

Wallace and Whimster (1951), in a study of 100 patients, have helped greatly in clarifying the subject and the following account incorporates many of their findings The elderly patients who complain of pruritus vulvae are likely to present with the following pathological conditions

Lichen simplex or localized neurodermatitis of the vulva —Many patients with pruritis ani et vulvae for which there is no apparent physical cause, develop the habit of rubbing and scratching the vulva and anal region This is particularly prone to occur in the emotionally unstable individual who has been unhappy or fatigued A vicious circle of scratching, lichenification, itching, scratching is set up which persists for months, even years, and results in lichenification, by which is meant thickening and oedema of the skin with hyperkeratosis

In the majority of cases the lichenification involves the skin of the groins and labia majora as well as the vulva itself However, there may be sodden white thickening of the mucosa over the clitoris and labia minora which can simulate very closely the changes of leukoplakia The presence of lichenification on the true skin and the history of attacks of irritation in which there is an irresistible impulse to scratch, should lead to the correct diagnosis

Lichen sclerosis —In this condition, which is probably a variety of scleroderma, there is a well defined shiny white atrophic change in the skin over the clitoris and labia minora extending usually to the labia majora The process is rarely confined to the vulva alone and often extends backwards to the peri anal region There may also be plaques of lichen sclerosis on the inner sides of the thighs and on other parts of the body

The line of demarcation between the diseased skin and the normal is very sharp The surface of the affected area may be roughened and show horny plugs and there are often telangiectatic vessels and areas of purpura where the dilated vessels have ruptured as a result of trauma

Superficial erosion and fissures are common and it is these which give rise to the symptoms of soreness and itching True leukoplakia may occur in association with lichen sclerosis complicating as it may, any chronic inflammatory disorder of the vulva

Senile vulval atrophy —According to Wallace and Whimster this corresponds to the original description of kraurosis The mucosa is smooth, shining and dry The colour is white or waxy yellow There is atrophy of all the muco-cutaneous teguments of the vulva leading to stenosis of the vaginal orifice, and the disappearance of the labia minora, frenulum and clitoris Primary atrophy is usually symptomless and symptoms only arise when infective dermatitis and vaginitis are superimposed A pre-senile type of atrophy may occur prematurely after oophorectomy

Leukoplakia —The hard bluish white patches of leukoplakia may arise on a vulva which shows no evidence of atrophy or inflammation or they may occur

superimposed on a pre existing disorder In this latter event the diagnosis is difficult and sometimes impossible without continued observation and histological examination It is however our belief that it is preferable to observe a case for some months and even carry out several vulval biopsies than to carry out needless vulvectomy The leukoplakic patches do vary considerably in their extent in the same patient when observed over a period of several months and what appears to be an irreversible change may involute and clear spontaneously If there is evidence of increasing induration and microscopic changes of increasing epidermal hyper plasia then surgery is indicated

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6

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Aet ology

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clear that the essential cause of varicose leg ulcers is chronic venous insufficiency with an associated great rise in capillary pressure. As a result of this there is damage to the capillary walls with loss of fluid into the limb and subsequent diminution in metabolic exchange. Capillary thrombosis may occur and later necrosis which produces the ulceration. Chronic venous insufficiency is most commonly caused by thrombosis of the deep veins (79·6 per cent of Anning's cases had post-thrombotic ulcers) but may be a result of varicosity of the deep veins or a lack of muscular contraction such as occurs in arthritis of the knees or ankles or in a job which entails prolonged standing. Bisgaard stresses the abnormal effusion of fluid into the tissues of the leg particularly around the calcaneo-malleolar region which he calls the "coulisse". It is a fact that the majority of leg ulcer patients have a persistent fullness around and behind the malleoli even when oedema cannot be demonstrated higher up the leg.

Treatment

The treatment of gravitational ulcers in the elderly does not differ from that in the younger age groups except that it is even more important to keep the patients ambulant. The keynote in treatment is to remove the excess tissue fluid from the leg: the ulcer will then heal. In a patient who is upright this must of necessity mean some form of compression bandaging. As Bisgaard pointed out, the muscular contraction in a leg compressed by elastic bandages helps to remove the oedema and the patient can be encouraged to walk.

Bandages.—Although adhesive elastic bandages are of great benefit, they have disadvantages as they may produce skin irritation from sweat retention or sensitization and they becomes sodden with discharge. We find that elastic webbing bandage applied from toes to knee are the treatment of choice. Any form of local application can be applied to the ulcer beneath them though personally we advocate the simplest application such as eusol in paraffin. Additional pressure on the ulcer edges can be achieved with sponge rubber pads and the persistent oedema around the malleoli can be pressed out by gamgee under the elastic bandages.

Massage.—In addition to the daily bandaging, massage on the lines advocated by Bisgaard stroking from the toes back to the heel and then upwards from the internal and external malleoli, is of great benefit.

Correction of anaemia.—Correction of anaemia which is a common associated condition also accelerates the rate of healing.

Follow-up of cases.—In the more severe cases the elastic webbing bandages have to be worn after the ulcer has healed and it is now our practice to "follow up" cured cases every 3–4 months to see that they are still wearing satisfactory bandages. The life of a bandage is 2–3 months. Elastic stockings are not as efficient as the bandages and we have had a number of cases relapse whilst wearing elastic stockings where previously they had remained well whilst wearing bandages. The finer grades of elastic bandage and crepe bandages do not exert sufficient pressure and, in our experience, are valueless.

Martorell's syndrome

In some hypertensive patients in the age group 60–70 years, ischaemic ulcers may appear on the legs spontaneously or after very trivial trauma. The syndrome was

reports
women,

Clinical picture

The ulcer occurs on the outer aspect of the leg at the junction of the lower and middle thirds It begins as a purplish painful patch which later blisters Superficial necrosis follows and the ulcer slowly enlarges by extension of the purpuric margin

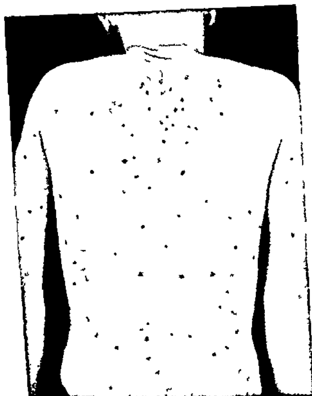


FIG 43 —Excoriations in an elderly man with infestation by pediculosis corporis

Pain, which is a prominent feature, is not relieved by rest in bed and the ulcer may continue to spread The ulcer may be bilateral This type of ulcer can be distingui shed from gravitational ulcers by the absence of phlebitis, oedema or pigmentation of the stasis type The ulcer itself shows no exuberant granulations which are such a feature of stasis ulcers The avascular ulcer of peripheral vascular disease can be differentiated by the presence in Martorell's syndrome of good peripheral pulsation and warm toes Hypertension is a constant finding, though in the authors' cases the blood pressure has been only moderately raised Histological studies by Hines and Foster have shown thickening and degenerative changes in the arterioles

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(4) The next day the painting is repeated, clean clothing is worn and the bedding changed

(5) On the next day the patient has a further blanket bath

Occasionally in patients with sensitive skin, benzyl benzoate itself causes a certain amount of irritation but if the emulsion has been applied to the whole of the skin as described above, the scabies will be cured and on no account must the painting be repeated in the idea that continued irritation means presence of the mite Such irritation following treatment can be relieved by the use of lin calaminae oleosa

Pediculosis corporis

Infestation with the body louse is, in our experience, much more common in old men than old women, probably because the infection is often picked up in common lodging houses The patients complain of intense irritation and show the most striking scratch marks on the trunk, particularly over the shoulder blades In addition, small red macules caused by bites are present and the diagnosis is made by finding the lice or the nits in the seams of the underclothes (See Fig 43)

Disinfestation—Since the insect lives in the clothing, disinfestation of this is necessary to bring about cure In ambulant patients this can be done satisfactorily by sprinkling the clothing and bedding daily with a powder containing 5 per cent DDT in talc

In bed ridden patients the bedding and clothing can be removed and disinfested by washing or at a public cleansing station and any nits or lice which may be lurking on the body killed by painting with benzyl benzoate emulsion

Pediculosis capitis

This is more common in old women than old men and must always be considered when the patient presents with pyoderma or impetigo of the scalp The nits are found most easily in the hairs in the occipital and temporal region, occasionally the whole scalp is crawling with pediculi

Treatment—[illegible]
its own adhere [illegible]
days the hair [illegible]
benzoate may only destroy the lice and not attack the eggs, since these hatch in seven days use of the emulsion for eight days will ensure that the insects are killed before reaching maturity

PSYCHOSOMATIC SKIN PROBLEMS OF THE ELDERLY

The special aspect of age such as loneliness and the frustration of increasing physical disability play their part in producing emotional problems which may show themselves in a variety of dermatoses The dermatoses are, however, in the main those which also affect younger age groups and are not, therefore, within the scope of this book Three conditions, however, by their resistance to treatment and the relative frequency with which they are seen in the elderly, appear worthy of discussion

near the ulcers The course of the ulcers is very chronic, though healing has occurred eventually in the authors' cases after periods of 6–9 months

True avascular ischaemic ulcers of the leg may occur in old age and are usually precipitated by trauma Here also pain may be very troublesome The diagnosis is made by the signs of occlusive arterial disease, possibly confirmed by x-ray evidence of calcification in the artery walls

Treatment

Local applications of eusol in paraffin have proved satisfactory since there is little risk of sensitization of the skin despite the many months of treatment Vaso dilator drugs have not appeared to influence the rate of healing

Even in the presence of gross occlusive arterial disease, such ulcers may heal if treated conservatively, provided the general condition of the patient is not deteriorating amputation should be delayed

Infestations

Diminishing standards of cleanliness

With the gradual mental deterioration seen in old age, standards of cleanliness often diminish and this, together with adverse economic circumstances often results in infestation Scabies and pediculosis are commonly seen in old people on admission to geriatric units and unless treated early such cases may give rise not only to general ward infection but may infect visiting relatives Such cases have come to our notice over the last few years

Scabies

This condition, due to infestation by the *Sarcoptes scabiei var hominis*, occurs at any age and must always be considered when the patient complains of irritation, particularly when the irritation is most marked at night In a book such as this, it is not necessary to give details of the typical burrow and sites of election but it is necessary to mention the so-called "Norwegian scabies" which is an unusual variety occurring occasionally in old people In this variety, irritation is often absent, there appears to be no immunity reaction in the skin and the lesions consist of hyperkeratotic crusted plaques present particularly on the dorsal aspect of the fingers and hands, and may affect the scalp in addition to other parts of the body In Norwegian scabies, burrows may not be present The diagnosis is made by scraping the hyperkeratotic crusts and examining microscopically directly under low power Enormous numbers of sarcoptes can be seen jostling each other in the debris on the slide Such cases may be undiagnosed and Ingram (1951) has reported such a case being a focus of scabies in a ward

Treatment —The best methods of treating scabies are still sulphur and benzyl benzoate We prefer the latter and it can be used successfully in bed-ridden patients In these patients we use applicatio benzylis benzoatis The routine we adopt for these patients is as follows

(1) The patient is given a blanket bath and dried

(2) The emulsion is painted with a paint brush on to the whole surface of the body from the neck to the soles of the feet and allowed to dry on

(3) The bedding is not changed following this painting

Case history

A history of a recent case will illustrate the type of problem

A 70-year-old woman complained that for the last two years she had been infested with threadworms which came out in the evening and travelled all over her body She could feel them come out of the anus and run up her back and they frequently bit her She had been unable to sleep because of the itching which started at the anus and spread over her whole body When asked if she had seen the threadworms she confessed that she had not because they were "too clever". Clinical examination revealed no abnormality of the skin

Cases are on record of delusion of parasitosis occurring in two members of a family, usually husband and wife, though we have seen it in father and son. Wilson (1952) and Wilson and Miller (1946) have classified the conditions in which these delusions occur and, in the aged, involutional melancholia and paranoid states due to alcohol, arteriosclerosis and senility are the probable causes

Treatment

The results of treatment are very disappointing Of 51 cases in the literature only 5 were cured and 4 improved This conforms with our own experience as we have seen no benefit from psychiatric treatment. Zaidens (1951) believes that these patients are essentially paranoid and that their skin symptoms save them from a frank paranoid psychosis Harm may therefore follow attempts to remove their delusion

POST HERPETIC PAIN

Perhaps the most difficult therapeutic problem in the elderly is that of post-herpetic neuralgia The probability that intractable pain will follow an attack of herpes zoster increases with the age of the patient and it is uncommon before the age of 55 years It is also said to be more likely when the trigeminal nerve is involved but herpes zoster seems to attack the trigeminal nerve more often in the elderly and the belief may be a result of this There is, as yet, no adequate explanation of the pathology of post-herpetic pain since the inflammatory reaction supposedly occurs in the posterior root ganglion and yet the pain is not relieved by section of the nerve proximal to the ganglion

Dolan and Bucy (1952) described a case of a man of 74 [illegible] undergone [illegible] herp[illegible] pai[illegible] From this they deduce that there is no alternative pathway for the pain of ophthalmic herpes and yet they admit that section of the trigeminal nerve will *not relieve* post-herpetic pain and that therefore disease in the peripheral nerve is not the cause once post-herpetic neuralgia has developed

[illegible] produces severe depression, loss of appetite and physical deterioration Suicide may occur The natural course of the condition is that after many months it slowly improves, though examples where the pain has persisted for 1-2 years are commonly seen

Glossodynia

Soreness or burning of the tongue is a common complaint and may occur in association with pernicious anaemia, the Plummer-Vinson syndrome, vitamin deficiencies, and as a result of local causes in the mouth such as allergic reaction to dentures, electro-galvanic discharge from metallic tooth fillings and extreme dryness of the mouth as in Sjogren's syndrome

When all these causes have been excluded there remains a group of patients who complain bitterly of symptoms referable to the tongue in whom no visible abnormality can be found As has been reported by Engman (1924) and Gilpin (1936) the patients are usually women and, in our experience, the elderly widow living alone is particularly prone to this oral neurosis The symptoms may have started after the chance observation by the patient of a particularly prominent circumvallate papilla or some other apparently abnormal landmark in the mouth The burning or pain in the tongue may be so severe that dentures cannot be tolerated or the diet so restricted that the patient becomes under-nourished When taxed with it many of the patients confess to examining their tongues countless times throughout the day As Gilpin pointed out, the majority of these patients have other functional symptoms and may give a history of previous neurotic episodes A fear of cancer is prominent in the majority though the fear may not be voiced The only physical sign we have observed has been rather prominent and reddened papillae around the edge of the anterior part of the tongue and this we believe is a traumatic condition due to the patient constantly moving the tongue and rubbing it around the teeth or palate to feel whether it is still painful It is often possible to observe this whilst talking to the patient

Treatment

Repeated full explanation of the symptoms and reassurance that the condition is not malignant produces temporary improvement, but many patients continue to have symptoms for years We have seen the most benefit in the elderly by altering the social state, living alone should, if possible, be prevented Local applications are of no value and are, we believe, a mistake since treatment confirms the belief of the sufferer that there is a disease to treat

Delusion of parasitosis

The false belief that the skin is infested with parasites is a not uncommon delusion which, though not confined to the elderly, is most common over the age of 50 years The symptoms complained of by patients exhibiting this delusion cover the entire range of symptoms of which the skin is capable Itching predominates but sensations of creeping, crawling, biting and moving have been described The skin lesions seen in this disorder fall into three groups The injuries due to the patient's attempts to remove the parasites by excoriations with the finger nails or other instruments, dermatoses due to chemicals utilized to kill the parasites, and manifestations of psychosomatic dermatoses such as lichen simplex In addition, the patient will often display a collection of skin scales and shreds of rolled up keratin which purport to be the "parasites "

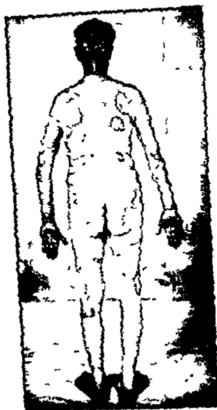


FIG 44—Erythema gyratum repens in a man with a carcinoma of the stomach (*With acknowledgements to Dr Doris Fletcher*)

disease and the onset of the dermatomyositis preceded the discovery of the malignant disease by an average of 18 6 months Clinical improvement followed the treatment of the neoplasm in 6 of the 8 cases

Erythema gyratum repens

A more bizarre eruption which occasionally occurs with carcinoma is erythema gyratum repens (Fig 44) This eruption, which occurs on the trunk, is made up of wavy erythematous bands with a peculiar gyrate and serpiginous outline giving an appearance like the grain marks in wood Gammel (1952) described this eruption in a woman of 56 years of age who developed it six months before an adenocarcinoma of the breast was discovered The eruption improved within two days of radical mastectomy and six weeks later had vanished We have seen a similar eruption in a man with an inoperable carcinoma of the stomach

Acanthosis nigricans

Although extremely rare, acanthosis nigricans must be included in this survey of the skin eruptions due to malignant disease Its rarity has been explained by Curth (1952) who suggests that both the benign and malignant types of this condition are due to a genetic predisposition, the exciting agent in the type associated with malignant disease being some hormonal change produced by the

Treatment

Numerous claims have been made for methods of treatment of herpes zoster which will prevent the onset of post-herpetic pain but since only a small percentage of elderly patients who suffer from herpes zoster develop post herpetic neuralgia, assessment of their worth is virtually impossible Amongst the more recent substances recommended have been aureomycin and chloramphenicol, liver extracts and vitamin B_{12} We have seen post-herpetic pain develop after all these and have failed to relieve fully developed cases with injections of liver extracts and vitamin B_1. Superficial x-ray therapy to the area also has its advocates but we believe that any benefit it may produce is by virtue of suggestion rather than its physical effect Despite this rather nihilistic view of therapy a good deal can be done for the patient by a full explanation of the problem and the assurance that although improvement will be slow, nevertheless patience and courage will ultimately be rewarded A combination of sedation with sodium amylobarbitone, grains 3 to 6 at night, and aspirin, grains 10 two-hourly, is of some benefit We have found that the average patient with post-herpetic pain of severe degree is too frail and old to be acceptable as a candidate for neurosurgery since leucotomy is dangerous when the cerebral vessels are arteriosclerotic

SKIN MANIFESTATIONS OF MALIGNANT DISEASE OF INTERNAL ORGANS

In the elderly, a constant watch must be kept for evidence of malignant disease and in recent years there has been increasing awareness of the changes in the skin which can be associated with internal carcinoma and the reticuloses The skin changes may occur long before there is any other clinical evidence of a neoplasm and therefore may be of great value in leading to an early diagnosis when curative treatment is still a possibility

Pruritus is most commonly associated with malignancy and carcinoma of the abdominal organs Hodgkin's disease and the leukaemias may present in this way There may be but little visible skin change, or small skin coloured papules with superimposed crusts due to excoriations may be present Rarely, a bullous eruption may occur in leukaemia (Scutt, 1952) and grouped blisters indistinguishable from dermatitis herpetiformis have been reported by Elliott (1938) in chorion carcinoma

Vascular changes such as palmar and facial telangiectasia which are usually associated with liver disease have been reported by Forman (1952) in two cases of carcinoma of the lung A more widespread fixed erythematous eruption with scaling resembling lupus erythematosus has been observed by us more than a year before the patient, a man of 63 years, was found to have a bronchial carcinoma Similarly, fixed erythematous eruptions (closely simulating the skin changes of dermatomyositis) have been described by Forman The association between carcinoma and a true dermatomyositis with skin changes and muscular weakness was first recorded by Bezecny (1935) and he described improvement after surgical removal of the carcinoma Forman (1952) also reported cases of dermatomyositis in association with carcinomas of the breast, stomach and a squamous celled carcinoma, the origin of which was never found Curtis, Blaylock and Harrell (1952) found that 8 out of 45 cases of dermatomyositis had underlying malignant

. . ...t after several . . scalp hair falls and occasionally the nails are ... y become thickened and opaque The superficial lymph glands in the axillae and groins are markedly enlarged but increase in size of the liver and spleen is unusual

Findings in the blood and plasma

Blood counts show a variable eosinophilic leucocytosis, the eosinophilia being highest in the most acute phase of the skin eruption The plasma proteins may fall after weeks of exfoliation and generalized oedema may result from this

Underlying lymphoma

The ...



FIG 45—Skin changes of exfoliative dermatitis

non-specific changes are shown, except in exfoliative dermatitis superimposed on psoriasis when the psoriasis histology may still be visible According to Jarrett and Kellett lymph node biopsy is of great value as the spec... foliative derma...
pale sta...
from the ...
to exclu...
specific ... cases ... showed no

tumour. The clinical picture is of warty overgrowths in the axillae and groins, umbilicus and peri-anal areas associated with pigmentation Occasionally hyperkeratosis of the skin of the hands and feet occurs The underlying neoplasm which can be forecast in 100 per cent of cases is always an extremely malignant adenocarcinoma usually within the abdominal cavity

Mycosis fungoides

Certain of the malignant reticuloses may occur in old age though the more common conditions such as Hodgkin's disease affect an earlier age group Mycosis fungoides is the most likely of the reticuloses to be seen and it usually follows a group of chronic erythematous and scaling eruptions which are resistant to all forms of treatment and which are included in the diagnosis of parapsoriasis The lesions may be extensive and involve the greater part of the body surface or may consist only of small plaques on the trunk After a long period, often 30–40 years, tumours may form on the skin previously affected by the parapsoriasis Very occasionally they arise *de novo* The tumour stage is called "mycosis fungoides" The tumours consist of pleomorphic reticulo-endothelial cells and at first are highly radio-sensitive The early treatment, therefore, is usually with small doses of x-ray therapy of the order of 100–300 roentgen units Gradually the tumours become radio resistant and the disease progresses to produce extensive skin ulceration and, lastly, infiltration of the internal viscera Although the disease is always fatal, the course is slow and spontaneous remissions may occur Regression of the tumours may follow treatment with the nitrogen mustard compound and in our hands, triethylene melamine has given the best results (Blackburn and King, 1954)

Exfoliative dermatitis

Another disease which has a relationship with the reticuloses is exfoliative dermatitis (lipomelanic reticulosis) (Fig 45) This condition which, in our experience, is more common in men than women may start spontaneously or more frequently develops from a pre existing dermatosis Jarrett and Kellett (1951) in a series of 16 cases found that generalized exfoliative dermatitis followed on eczema, seborrhoeic dermatitis and contact dermatitis It may be a complication of extensive psoriasis and can be precipitated by allergy to drugs such as gold and arsenic Once developed, the clinical picture of generalized exfoliative dermatitis is similar in all cases and it is not possible to determine the nature of the exciting cause from the appearance of the eruption The patients complain of intense itching which prevents sleep and produces a mental depression so that they are easily moved to tears Jarrett and Kellett (1951) and Nairn and Anderson (1955) stress the frequency of psychological upsets and quote examples of relapses which have been precipitated by emotional stress Attacks of profuse sweating associated with feelings of coldness and even rigors are common which are due to derangement of the normal skin heat-regulating mechanism The skin of the whole body becomes red or purplish, thickened, oedematous and inelastic so that creases form over the extensor aspects of the knees and elbows Visible excoriations can usually be seen and the skin feels moist and sticky Exfoliation is a constant feature and several grammes of skin scales can be collected daily in the bed

and contrary to popular belief are not associated with internal malignant disease

Cutaneous tags are commonly seen in middle-aged and old people as small filiform excrescences particularly around the neck in women and the axillae in men The cause of these is unknown but it has been suggested that they are produced by some hormonal influence The easiest way of removing them is to snip them off with scissors and use a silver nitrate pencil to stop any slight bleeding which may occur others use electro-cautery or diathermy



FIG 46 —Seborrhoeic warts in various stages of evolution.

Seborrhoeic or senile warts are very common in the elderly (Fig 46) Both sexes are affected and they often occur in great numbers on the [illegible]

[illegible] is no tendency to invasion and [illegible] Treatment if required is simple [illegible] carbon dioxide snow the pencil [illegible] for 30 to 60 seconds depending on the thickness of the lesion or, more certainly by curetting under local anaesthesia and cauterizing the base with a silver nitrate stick

Treatment

Cortisone and corticotrophin.—The dosage of cortisone necessary to control the exfoliative process is 100–200 milligrams daily or corticotrophin, 25–50 units intramuscularly Improvement is noticeable within 48 hours and within a week the skin may appear almost normal In our experience most of the cases have required a small maintenance dose of 25–50 milligrams of cortisone to prevent relapse and the only complications which have proved troublesome have been a tendency to develop small superficial boils

Corticotrophin and cortisone have altered the prognosis greatly and in the Medical Research Council Report of 1954, 9 out of 10 cases were cleared of their skin eruption by 1 or 2 short courses of corticotrophin or cortisone and the tenth case remained clear on a maintenance dose of corticotrophin

Local treatment.—With the use of cortisone local treatment has become less important and all that is necessary is the application of soothing emollients such as lot calaminae oleosa or ung aquosum Despite the control of the exfoliative dermatitis by cortisone, irritation has persisted in our cases for many months and we agree with Jarrett and Kellett that these individuals have frequently a background of emotional stress This aspect of the problem should be investigated and if possible, appropriate steps should be taken to relieve their anxieties

Prognosis

Exfoliative dermatitis runs a very protracted course and carries a considerable mortality, death usually being due to intercurrent infection Spontaneous recovery does occur and in Jarrett and Kellett series 5 out of 16 cases went into remission Relapses however, are frequent

NEW GROWTHS IN THE AGED

It is out of place in a book such as this to give any but the common types of neoplasm encountered in the aged The exotic and rare small nodule, the diagnosis of which usually depends on the histological picture, is left to the consideration of the dermatologist As one would expect, from the senile skin commonly arise many different types of neoplasms which are best considered under the headings of benign, premalignant and malignant

Benign neoplasms

On the exposed surface, the ageing skin becomes parchment-like with loss of elasticity In the areas, pigmented macules and sometimes small telangiectases appear On the back of the neck the skin is often thickened with loss of elasticity and the appearance of deep intersecting creases giving rise to cutis rhomboidalis nuchae or elastosis senilis In this condition, there is degeneration of the elastic tissue in the skin

Senile angiomas or de Morgan's spots are another form of degenerative change seen in the mesodermal layer of the skin These appear after middle life as deep red, slightly raised papules particularly on the trunk They are of no significance



FIG. 48.—Basal-celled epithelioma of the cheek in a woman 65 years of age

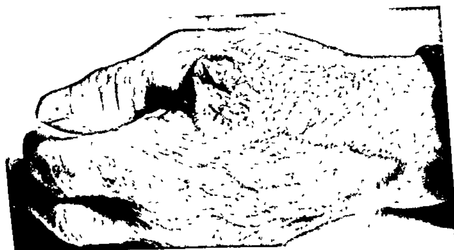


FIG. 49.—Squamous epithelioma on the back of a hand.

Acanthoma, molluscum sebaceum or *molluscum pseudo carcinomatosis* has only been really recognized as an entity during the last few years These lesions can occur at any age but are mentioned here because of their close resemblance to squamous epitheliomas which occur commonly in the elderly The acanthoma occurs usually on the face, it starts as a small flesh-coloured papule which in the course of 2 or 3 weeks rapidly grows to become a protruding angry looking nodule up to a centimetre in diameter and extruding the same distance from the



Fig 47—The unusual hyperkeratotic lesions on the foot of a man with Norwegian scabies

skin The edge of the tumour is redder than the surrounding skin but dilated blood vessels are not seen coursing over the edge as with epitheliomas There is no induration of the surrounding skin, and the surface is warty and often the centre of the nodule is depressed Bleeding is uncommon Histologically there is marked acanthosis of the epidermis and differentiation from the squamous epithelioma often requires expert opinion If left untreated after several weeks the lesions shrivel, become necrotic and drop off leaving often a marked depressed scar They are best treated by curetting under local anaesthesia and cauterizing the base with silver nitrate, the scarring produced is much less than if the nodule is left to drop off naturally

... central crusting and ulceration Histo- ... elongation

... hoea- ... less common varieties ... true that ... not ... deep

... sensus of opinion appears gradually ... tumours derived from arrested embryonal primary epithelial germs (Lever ...)

Treatment —Where practicable, excision is the best and surest way of quickly getting rid of these lesions, but in areas where such a procedure is impossible, either because of size or position, radiotherapy is the best method.

Squamous cell epithelioma

This may occur anywhere on the skin or mucous membrane and may arise from a pre-existing senile keratosis or area of leukoplakia The lesions are more common on the exposed surface and one sees them arising occasionally on skin damaged by burns, x-irradiation and lupus vulgaris Lesions arising on previously ... may at first resemble an early rodent ulcer but the squamous-epitheli- ... the ulcerative and ... wide raised indurated border in which ... prob- ... large cauliflower-like tumour rapidly develops in which there is ... blood supply

... pearls It is noteworthy that ...

... stasis Treatment again consists of either excision or radiothe...

Bowen's disease

This is a variety of intra-epidermal epithelioma and is probably more common ... and often superficially ... n present for many ... ngth The surface is ... If left alone the ... of the epidermis and a true squamous epithelioma is established Treatment consists of complete excision or as an alternative we have found freezing for up to 90 seconds with carbon dioxide snow to be very effective

Metastatic carcinoma

Secondary deposits resulting from primary carcinoma in other organs occur in the skin but with the exception of carcinoma of the breast, they are rare The lesions

Premalignant neoplasms

Senile keratosis occurs often as multiple lesions on the exposed parts particularly in fair-skinned people who have spent most of their life out-of-doors in hot sunny climates The lesions are slightly raised, scaling and often pigmented, the scales are firmly adherent to an erythematous base Squamous carcinoma develops in 20 to 25 per cent of these lesions (Montgomery and Dorffel, 1932) Histologically, according to Lever (1954), it is a pre-cancerous lesion differing only in degree from squamous-cell carcinoma or Bowen's disease

In view of the nature of these lesions they must be treated with respect and watched for any sign of proliferation or increasing induration In the premalignant state it is our practice to destroy them with electro-coagulation

Cutaneous horns are peculiar bizarre tumours sometimes reaching great size and *rising several centimetres above the skin. Lever regards these as being a type of* keratosis with a particularly pronounced hyperkeratosis, although clinically it appears that some may arise from simple warts The most effective treatment is simple excision

Arsenical keratoses are still seen in the elderly as a heritage from the days when long-continued administration of inorganic arsenic was customary in the treatment of various chronic diseases The keratoses may appear many years after the taking of the arsenic has ceased The lesions may occur on the palms and soles or pigmented keratotic plaques may be present on the trunk Histologically the lesion closely resembles that of senile keratosis

Lentigo maligna —Not infrequently there appears, for no apparent reason, a pigmented slightly-raised plaque on the face of an old person, the colour may vary from light brown to deep black and the colour of the lesion in each individual may vary Watching these lesions over months and years they are often found to migrate, extending, regressing, and occasionally clearing for a time in the centre, occasionally, sometimes after many years, a true malignant melanoma appears in one part of the lesion There is deepening of the colour, proliferation, *induration and sometimes ulceration*

How best to deal with lentigo maligna is still in doubt A great deal depends on the expectation of life of the patient with regard to his general condition, but even though he looks as though he will live for another twenty years after the appearance of the lesion, it is still very difficult to decide whether or not the whole area should be completely excised when it is still unlikely that malignant change will supervene At present the best policy is probably one of masterly inactivity with constant supervision The onset of the first suspicion of malignant change warrants wide excision

Malignant neoplasms

Rodent ulcer, basal-cell epithelioma

These tumours also may occur at any age but are much more common in the elderly (*See* Fig 48) They occur most commonly on the face and particularly in the area enclosed by lines drawn from the ear to the bridge of the nose and to the angle of the mouth The characteristic lesion is a small slowly-growing nodule having a raised semi-translucent pearly edge over which may be seen streaming a few small

CHAPTER 9

GYNAECOLOGY IN SENESCENCE AND SENILITY

C Scott Russell

INTRODUCTION

The gynaecologist often has much to offer the older woman in the way of treatment he has been treating her kind for years and knows that she is made of mature and sturdy stock, and that she will appreciate all efforts made on her behalf The gynaecology of old age is nearly all surgical and the gynaecologist has learnt that the old woman is a much better surgical risk than those who are not familiar with present-day gynaecology may have thought, indeed she is sometimes a better surgical risk then he himself has realised Gynaecological operations are now being undertaken successfully on patients who ten and fifteen years ago had been judged too old for the self same operation With the increasing expectation [illegible]

bility for the care of the older woman should understand *the scope of modern* treatment

Much that is new in the gynaecology of old age has little or no meaning unless viewed in the light of the older and well tried aspects of the specialty *A review of* modern trends must take *into* account this matter, which *is the basis for the* day to-day care of the older *patient* and which must always *remain the foundation* on which new knowledge is built

HISTORY TAKING AND METHODS OF EXAMINATION

History taking

These *matters are* mostly the same as those used in younger persons though here and there the emphasis *may be a little different* History taking may be considered first though there are occasions when so *confused a story* is given by the patient *that* examination should precede the history Sometimes a history from a relative or neighbour is helpful It is wise, *where possible* to see the woman up and about because so much can be learned by *the woman's* walk and bearing The woman who is independent is usually quite fit for any gynaecological surgical procedure likely to be required even those *who require* some help may yet be suitable subjects for surgery If the woman is first seen on a couch a decision for or against operation may be *more difficult*

usually present as firm raised erythematous nodules and the diagnosis can be only made with certainty by biopsy. The other changes occurring in the skin as a result of internal malignant disease have been discussed elsewhere

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Diagnosis

On examination the cervix may be found ulcerated or nodular or there may be an obvious growth projecting into the vagina, diagnosis is more difficult when, as is sometimes the case, there may be little alteration to be seen in the cervix or only some expansion as in the endocervical growth The important physical signs are that the cervix bleeds on swabbing, and that it is friable Friability may be tested by probing, and in many cases this simple test establishes the diagnosis without any reasonable doubt, nevertheless biopsy is required in all cases

Treatment

The choice of treatment of carcinoma of the cervix lies between radium and deep x ray therapy (preferably supervoltage), or surgery or some combination of the two As a rule, however, treatment should be by radium and x rays for this is much simpler and immediately safer than the extended abdominal hysterectomy with pelvic lymphadenectomy, which is the surgical alternative This operation, which comprises the removal of the uterus and appendages, the greater part of the broad ligament, and one third to one half of the vagina, together with the pelvic lymphatic glands will be reserved for cases not suitable for or not responding to radiotherapy It is however a very formidable operation and will seldom if ever be advised for the elderly patient

Management of the recurrent case

About a third of all cases of cervical carcinoma will be cured by treatment, the remainder dying of recurrence Many difficulties are present in the management of such cases Recently, surgical removal of the recurrent growth has been advocated mainly on the grounds that many such growths are localized to the pelvis This operation is spoken of as a pelvic exenteration Sometimes only a partial operation is advised, either an anterior exenteration where the bladder, uterus, parametria, vagina and lymph nodes are removed, or a posterior exenteration which leaves the bladder but removes the uterus and pelvic colon and rectum together with the cellular tissues and lymphatic nodes The place of these operations has been very fully discussed by Blaikley, Way, Read and others (1953), and readers are referred to this source for further details In the elderly patient it will generally be felt that pelvic exenteration is out of the question and that simpler measures to relieve the suffering will have to be adopted

Radium reaction

There is a further difficulty in this connexion, for a *radium reaction* may be present, and may be mistaken for local recurrence Initially, the radium reaction presents as widespread induration and oedema, clinically very [illegible]
extens[illegible]
away [illegible]
proce[illegible]
starte[illegible] necrosis which [illegible] after the radium treatment was continuing 2½ years later

Pain

For other late cases, pain [illegible]
may be required Intras[illegible]
follows The woman is p[illegible]

Examination

The general examination of the patient is discussed in other sections of this book. Clearly the greatest care must be taken in this examination because general faults, nutritional defects, and the like may be of even greater moment in a woman in the later years of her life Here we may concern ourselves particularly with the special examination of the gynaecological patient Abdominal examination must never be omitted, because all kinds of pelvic and other tumours are found in the aged If some swelling is found, it is wise to remember that it need not necessarily be in any way responsible for the symptoms, this applies particularly to uterine fibroids which may be quite quiescent in elderly women At the time of the abdominal examination the inguinal region should be examined for enlarged lymphatic nodes, hernia, or other fault

Careful examination of the vulva, urethra, and anus is next required for signs of inflammation or ulceration, tumours, or other faults Any discharge or prolapse will be noted Vaginal examination may be more difficult in the elderly than in the younger patient, for the vagina may be narrow, only admitting one finger. Adhesions at the vault and shrinkage may make examination of the cervix unsatisfactory In cases of difficulty, a rectal examination or a combined examination with one finger in the rectum and one in the vagina often gives much more information, the rectal finger reaches to a much higher level, allowing the pelvic organs to be palpated, and the two fingers together allow direct palpation of the pouch of Douglas, occasionally by this technique secondary peritoneal deposits of carcinoma can readily be felt between the two fingers

In most cases, a narrow bladed speculum should be passed so that inspection of the vagina and cervix can be made A specimen of any discharge may be sent for examination Any retained foreign body or pessary will be noted Very occasionally placing the patient in the knee-chest position thus allowing air to enter the vagina enables a much more detailed examination of the vagina to be made Other methods of examination occasionally required include the passage of a sound into the uterus, and endometrial or cervical biopsy Grasping the cervix with a tissue forceps and drawing it down may demonstrate the extent of a prolapse Rectal examination and proctoscopy may also be indicated

CARCINOMA OF THE CERVIX

Typically, the early carcinoma of cervix causes vaginal bleeding and a malodorous blood-stained discharge, sometimes profuse haemorrhage occurs Exceptionally if the carcinoma be slow growing there may only be discharge Pain is not an early symptom, and when present it usually means considerable extension of the growth process Growth is not always as rapid as in the younger woman The principal avenues of spread of carcinoma of the cervix are to the vagina, to the parametrium and utero-sacral ligaments, to lymphatic glands, and later to bladder and rectum In late cases, there may be incontinence of urine or faeces in some late cases the extension of the growth in the broad ligament leads to compression of the ureters with increasing obstruction to the urinary outflow, and eventually complete urinary suppression, the disease may even present as uraemia The growth is usually a squamous epithelioma, though adenocarcinoma also occurs

Diagnosis

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is advised, *either* [illegible]

Radium reaction

There is a further difficulty in this connexion, for a radium reaction may be present, and may be mistaken for local recurrence Initially, the radium reaction presents as widespread induration and oedema, clinically very similar to the signs of extension of the growth *later necrosis* may occur and the tissues involved slough away Bladder and rectal fistulae often result The necrosis may spread and the process continue for some years In one case known to me, the necrosis which started 11 years after the radium treatment was continuing 2½ years later

Pain

For other [illegible]
may be [illegible]
follow [illegible]

of the spinal cord, a lumbar puncture is performed, and ½–1 millilitre of sterile absolute alcohol is injected. Often there is an immediate feeling of warmth, and pain is relieved; this injection may be repeated. Good results have also been reported by the use of chlorpromazine.

Urinary incontinence

Urinary incontinence can be troublesome if the bladder has been invaded and a vesico-vaginal fistula has resulted. Nursing on a rubber bed pan helps to keep the bed clothes dry.

Vaginal smears in the diagnosis of early uterine malignancy

So many cases of carcinoma of the cervix are only diagnosed when the condition is well advanced that much thought has been given to the detection of these cases at an earlier stage of the disease. In recent years, the routine examination of smears obtained from the vagina and cervix as a means of recognizing early or recurrent uterine cancer has been extensively studied. Even under normal conditions the superficial cells in the female genital tract are constantly being exfoliated but in carcinoma the cells are dividing so rapidly and being shed so frequently that it was thought a study of the vaginal secretions might bring to light the early cases. Numerous methods for collecting the material have been described. Papanicolaou and Traut (1941) employed a curved glass pipette and rubber suction bulb, other methods include the use of a damp standard cotton swab protected by a sheath of rubber tubing (Kraushaar, Bradbury, and Brown, 1949). On the other hand, Ayre (1947) believed that it was better to take the smear direct from the external os, and he designed a spatula specifically for this purpose. A thick smear is made on a glass slide and this is immeresd in an alcoholic solution and stained later with one of the appropriate stains. The appearances of the cells that lead to a diagnosis of carcinoma are the same as those seen in ordinary paraffin sections, but as Read (1952) reminds us, considerable experience is required to ensure accuracy of diagnosis. Furthermore, about 10 per cent of the malignant growths of the uterus do not exfoliate, so this particular technique in no way solves all the problems of the diagnosis of early cancer.

There seems no doubt that by these techniques an occasional early case of carcinoma can be detected, but the method is not without its disadvantages. There is an enormous time wastage, some 500 hours of work having been estimated as being necessary to reveal one carcinoma. Furthermore, there are great difficulties in securing sufficient trained staff. There are the further drawbacks that the methods can only be a guide to the choosing of those cases that should be more thoroughly examined by the orthodox methods of diagnostic curettage and cervical biopsy and that much unnecessary investigation of those with innocent lesions is inevitable.

CARCINOMA OF THE CORPUS UTERI

Clinical features

Carcinoma of the corpus uteri also presents as post-menopausal bleeding, but unlike carcinoma of the cervix, which is the commoner form of carcinoma, it causes a discharge which is only malodorous at a comparatively late stage as

secondary infection occurs late rather than early Clinically detectable uterine enlargement is not always present, this is an important point because the absence of enlargement must not be taken to exclude carcinoma In late cases extension of the growth to the cervix may result in a mass being felt protruding through the cervix and into the vagina, sometimes the whole of the upper part of the vagina is filled with carcinoma Occasionally, carcinoma of the corpus uteri presents with secondary deposit in the lower third of the vagina A pyometra may be present Diagnostic curettage and histological examination of the material obtained is necessary in all cases

Spread

The spread of carcinoma of the corpus uteri is by continuity to the cervix and vagina and through to the peritoneum to the ovaries and to the pelvic and pre-aortic lymphatic glands The spread is later than with carcinoma of the cervix because the myometrium is quite an efficient barrier for a while, consequently the prognosis is rather better The growth is usually an adenocarcinoma

Treatment

Treatment may be by radiotherapy or by operation, or some combination of the two Operation has a much larger place in the treatment of carcinoma of the corpus uteri than carcinoma of the cervix because a simpler and less drastic procedure often appears to remove the growth completely Recurrence at the vaginal vault however has been all too common and so the modern trend is to advise a radical operation or more often some combination of surgery and radiotherapy Willmott Dobbie (1953) for example has reported on a comparison between cases of carcinoma of the body of the uterus treated by total abdominal hysterectomy alone and cases that were treated by x ray therapy or vaginal radium following hysterectomy The results showed clearly that the best results were obtained when the hysterectomy was followed by vaginal radium An extension of this treatment advocated by Dobbie is the irradiation of the whole vagina in order that recurrence even in the lower third, may be prevented

Some elderly women will be judged not fit subjects for surgery In those cases, radiotherapy alone should be strongly advised because it is often very successful, indeed some radiotherapists maintain that the results of radiotherapy are quite as good if not better than, those in which surgery has been used

SARCOMA OF THE UTERUS

Sarcoma of the uterus arising *de novo* or developing in a fibroid is a very rare malignant pelvic tumour Rapid uterine enlargemen

BENIGN UTERINE LESIONS

Fibroids

Uterine fibromyomas are very common tumours and though they generally cause symptoms during the reproductive life of the woman they may cause symptoms

after the menopause, alternatively they may be discovered during a routine examination

Generally speaking the fibroid will not cause symptoms unless some change or degeneration is taking place The most serious, though rarest, of these changes is the development of sarcoma in a uterus enlarged with fibroids Pain is a feature of this development, and a rapid enlargement of a uterine swelling may be detected Hysterectomy offers the best hope of cure, though radiotherapy can have very beneficial results if the tumour is radiosensitive

After the menopause a progressive shrinkage of the uterus occurs If a uterine fibroid is present, this shrinkage may have the effect of forcing the fibroid into the endometrial cavity when eventually it may be extruded from the uterus and come to lie in the upper part of the vagina as a fibroid polyp In such cases, irregular bleeding will occur

Polypi

The principal other benign uterine lesions are the various polypi Endometrial polypi occurring after the menopause cause post-menopausal bleeding Diagnosis is made by curettage which effectively treats the condition at the same time Cervical polypi are also common, and vary from a tiny symptomless adenomatous tag at the cervix to a substantial fleshy mass which may have a pedicle of such length that it protrudes outside the vulva Treatment by avulsion of the polyp presents no difficulties and may often be possible in consulting room or Out-patient Department The only important point is that section of the tissue removed is required in every case

CARCINOMA OF THE OVARY

Carcinoma of the ovary is one of the most difficult of all carcinomas to diagnose at an early stage, and is one which often would carry a nearly hopeless prognosis were it not for the fact that some tumours remain localized to the pelvic organs for quite a while and others are extremely radiosensitive

Diagnosis

The symptoms of ovarian carcinoma are so vague and ill-defined that medical attention is often not directed to the pelvic organs for some time, and pelvic examination in consequence not made, or delayed Lower abdominal pain and discomfort of recent onset in an elderly woman should always rouse the suspicion of ovarian carcinoma Careful bimanual examination perhaps with one finger in the rectum and one in the vagina may detect some fault in the ovaries or in the pouch of Douglas If examination is difficult or the findings equivocal, examination under anaesthesia is required Even this may be difficult to interpret, perhaps because of obesity, in such circumstances the pouch of Douglas may be opened and the pelvic organs directly palpated

Occasionally there is doubt about *the significance of a small ovarian swelling* and more particularly whether the abdomen should be opened or not A useful guide is that if the ovarian swelling is larger than the uterine fundus it is abnormal,

and the abdomen should be explored In other cases, the difficulty is not to locate a swelling but to decide whether a particular mass which may be felt is benign or malignant Loss of weight, rapid abdominal enlargement, fixity and irregular consistency of the swelling and ascites should all point towards malignancy

Rarer ovarian tumours

The malignant lesion of the ovary may take many forms The primary and secondary carcinomas show differing histological patterns The special form of

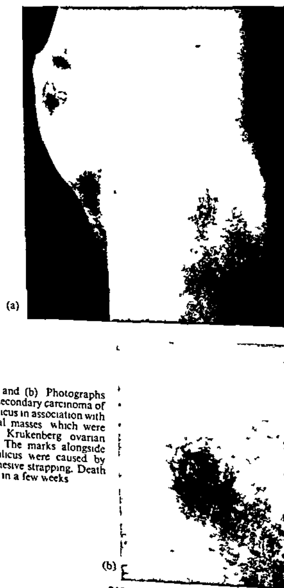


FIG 50—(a) and (b) Photographs showing secondary carcinoma of the umbilicus in association with abdominal masses which were probably Krukenberg ovarian tumours The marks alongside the umbilicus were caused by some adhesive strapping. Death occurred in a few weeks

after the menopause, alternatively they may be discovered during a routine examination

Generally speaking the fibroid will not cause symptoms unless some change or degeneration is taking place The most serious, though rarest, of these changes is the development of sarcoma in a uterus enlarged with fibroids Pain is a feature of this development, and a rapid enlargement of a uterine swelling may be detected Hysterectomy offers the best hope of cure, though radiotherapy can have very beneficial results if the tumour is radiosensitive

After the menopause a progressive shrinkage of the uterus occurs If a uterine fibroid is present, this shrinkage may have the effect of forcing the fibroid into the endometrial cavity when eventually it may be extruded from the uterus and come to lie in the upper part of the vagina as a fibroid polyp In such cases, irregular bleeding will occur

Polypi

The principal other benign uterine lesions are the various polypi Endometrial polypi occurring after the menopause cause post-menopausal bleeding Diagnosis is made by curettage which effectively treats the condition at the same time Cervical polypi are also common, and vary from a tiny symptomless adenomatous tag at the cervix to a substantial fleshy mass which may have a pedicle of such length that it protrudes outside the vulva Treatment by avulsion of the polyp presents no difficulties and may often be possible in consulting room or Out-patient Department The only important point is that section of the tissue removed is *required in every case*

CARCINOMA OF THE OVARY

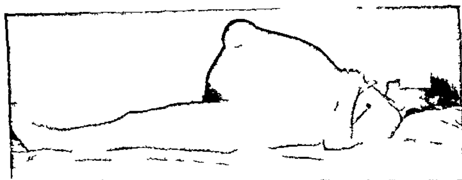
Carcinoma of the ovary is one of the most difficult of all carcinomas to diagnose at an early stage, and is one which often would carry a nearly hopeless prognosis were it not for the fact that some tumours remain localized to the pelvic organs for quite a while and others are extremely radiosensitive

Diagnosis

The symptoms of ovarian carcinoma are so vague and ill-defined that medical attention is often not directed to the pelvic organs for some time, and pelvic examination in consequence not made, or delayed Lower abdominal pain and discomfort of recent onset in an elderly woman should always rouse the suspicion of ovarian carcinoma Careful bimanual examination perhaps with one finger in the rectum and one in the vagina may detect some fault in the ovaries or in the pouch of Douglas If examination is difficult or the findings equivocal, examination under anaesthesia is required Even this may be difficult to interpret, perhaps because of obesity, in such circumstances the pouch of Douglas may be opened and the pelvic organs directly palpated

Occasionally there is doubt about the significance of a small ovarian swelling and more particularly whether the abdomen should be opened or not A useful guide is that if the ovarian swelling is larger than the uterine fundus it is abnormal,

later a more severe attack with vomiting causes the woman to consult her doctor The findings are an abdominal or pelvic swelling of moderate size which is tender Though the swelling is usually situated in the lower abdomen and pelvis it may be anywhere in the abdomen For example a right sided ovarian cyst may twist on its pedicle and present as a visible swelling even in the left hypochondrium Other complications of ovarian neoplasm for example haemorrhage rupture and infection cause less clear-cut signs and symptoms than torsion



F G 51 —Pre-operat ve appearances in a case of pseudomyxoma per tone At operat on two and a half bucketsful of material were removed The woman l ed for a further three years

Pseudomucinous cyst

The pseudomucinous cyst of the ovary is generally benign multilocular and un lateral the most distinctive characteristic is that it can grow to a great size The late Professor Dougal in his notes to students quoted the case of one such cyst (found at *postmortem* in the 18th Century) which contained not above a pint less than 30 gallons wine measure The pseudomucinous cyst can often be removed without difficulty and therefore no patient should lightly be judged too old or too frail for this to be done A recent patient of mine was successfully operated on at the age of 87 years when bilateral ovarian cysts were removed one of which contained 15 pints of fluid

Th s type of cyst provided it is not too h

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operation at which two and a half bucketsful of exudate were removed

Serous cyst

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secondary ovarian carcinoma, the Krukenberg tumour, deserves special mention because the mobility of the tumours which are bilateral may result in their being mistaken for some benign lesion Fig 50 shows such a case having in addition a secondary deposit in the umbilicus

The dysgerminoma which is histologically identical with the seminoma probably never occurs after the menopause though one case has been reported in a patient aged 52 years The functioning ovarian tumours comprising, on the one hand, *the granulosa cell carcinoma, the thecoma* and *the luteoma*, and on the other hand, the arrhenoblastoma are of variable malignancy but are included in this section The former group occur after the menopause when their feminizing propensities cause post-menopausal uterine bleeding According to Novak there is no effect on secondary sex characteristics, but the removal of the tumour may lead to a second menopause from the standpoint of vasomotor phenomena The masculinizing tumours also occur after the menopause though they are very much rarer *than the feminizing ones*

Treatment

Treatment of suspected ovarian carcinoma is always laparotomy so that the extent of the disease may be observed and every patient given every chance (*see* ovarian fibroma) In some cases, widespread dissemination throughout the abdomen is found, when treatment can only be symptomatic, in such cases it is often not possible to diagnose whether the site of the primary growth is ovary or elsewhere In other cases in which the prognosis is not hopeless, wide excision of the growth should be undertaken and biopsy made of adjacent structures where possible Valuable information as regards prognosis and desirability of radiotherapy may be obtained from the histological examination of sections of peritoneum, or omentum, or lymphatic glands that have been partially or completely removed at operation In all cases in which at operation it is thought that complete removal of the growth has not been achieved, the opinion of a consultant radiotherapist should be sought because some of these growths are very radiosensitive

BENIGN OVARIAN NEOPLASMS

Benign ovarian tumours are not uncommon in elderly women They are very varied both in their pathological and clinical features, and for full description readers are referred to standard gynaecological works on the subject Here it will suffice if the main features of some of the types are described

Special complications

First, however, the special complications of benign ovarian neoplasm deserve mention New growths of moderate size may twist on their pedicle and cause acute symptoms and signs which are often quite typical There may be a history of several attacks of lower abdominal pain on the left or on the right side according to whether the growth has arisen from the left or right ovary, and these attacks of pain may last a few days and pass off, only to recur at a later time Sooner or

Symptoms

The expression genital prolapse is a convenient one to describe the whole subject of prolapse, and it comprises urethrocele, cystocele, vault prolapse, procidentia, enterocele or pouch of Douglas hernia, and rectocele, either alone or in combination The most severe forms of prolapse may endanger life, for example, fatal intestinal obstruction has followed the strangulation of a loop of intestine in the peritoneal pouch of a procidentia A less dangerous complication is the obstruction to ureter and consequent hydronephrosis associated with long standing severe prolapse These are rare events and on the whole genital prolapse is a benign condition whose importance lies in the symptoms it causes

These symptoms which are very varied depend in large measure on the variety of prolapse present Often a feeling of something coming down and the presence of a swelling outside the vulva are the main complaints Discomfort on sitting, difficulty in walking are associated symptoms Urinary symptoms vary from frequency and urgency and stress incontinence in early cases to difficulty with micturition in late cases Sometimes micturition cannot be started until the prolapse has been returned Pain is not a feature of prolapse in the elderly, probably bec...

...very similar to those of genital prolapse Cystitis, vaginitis, and polypi are examples of lesser conditions to be kept in mind when examination is made A vaginal cyst or a bladder diverticulum should also be kept in mind (Fig 52) The diagnosis of the established prolapse presents no difficulty Lesser degrees can usually be correctly assessed provided the differential diagnosis is remembered In elderly women with a short history of illness prolapse is not a likely explanation for symptoms nor are symptoms that are worse in the morning likely to be caused by genital prolapse

Treatment

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The Manchester repair operation

The operation most often advised for the treatment of the prolapse is the Manchester repair operation This operation which comprises an anterior colporrhaphy amputation of the cervix, *and shortening* of the transverse cervical ligament and posterior colpoperineorrhaphy has stood the test of time and is one of the very best of all surgical proced...
... almost *certain that the*
...ing concerned with the

...effective in treating symptoms such as urgency and frequency of micturition and stress incontinence *or* pelvic pain Alternative

Dermoid cyst

The dermoid cyst is not a common growth in elderly women, it does not reach to any size and is benign; it is particularly liable to torsion

Ovarian fibroma

The ovarian fibroma occupies a special place in the consideration of ovarian neoplasms in the elderly because, though a benign tumour, its clinical features are such that it may easily be misdiagnosed as ovarian cancer with widespread peritoneal and pleural metastases Ascites, which may be massive, and hydrothorax, are the added features (Meig's syndrome), which may lead to the erroneous diagnosis of malignancy In some cases, diagnosis may be even more difficult because of haemothorax rather than hydrothorax Treatment of ovarian fibroma presents no real difficulties



FIG 52 —Calculi in a diverticulum arising at the bladder urethral junction

GENITAL PROLAPSE

Aetiology

Though childbearing is an important contributory factor in the aetiology of genital prolapse other factors are also important In particular, the loss of elasticity and general atrophy of the pelvic supports such as may develop after the menopause are the changes which lead to the appearance of the prolapse at this time.

Dribbling incontinence due to urinary fistula

Dribbling incontinence day and night should always arouse the suspicion that it may be the result of a urinary fistula which the woman may have had and put up with for many years Fig. 53 illustrates complete destruction of the vesico vaginal septum in a patient who had been incontinent for forty nine years before she came for treatment then it was only some pain and bleeding due to ulceration of the prolapsed bladder mucosa which compelled her to seek advice In her case transplantation of ureters into colon was carried out successfully Another old woman was found to have a urinary fistula complicating her procidentia (Fig 54)

Advanced carcinoma of the cervix involving the bladder is another cause of fistula The late effects of radiation treatment of carcinoma of the cervix even though the cancer is cured may also cause this urinary fault in the elderly woman The radiation necrosis may develop some years after the radium treatment

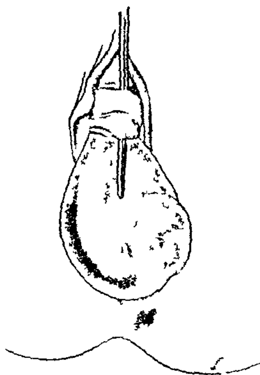


FIG 54 —Drawing showing procidentia and vesico-vaginal fistula A bladder sound has been passed through the urethra and out through the fistula

Diagnosis of urinary fistula

The diagnosis of a urinary fistula does not usually ...
occasionally however ...
condition may pass u

operations that are favoured by some are vaginal hysterectomy with repair of the pelvic floor and such operations as the Lefort operation, by which the vagina is partially occluded and the prolapse so held back

Pessaries

The pessary as a treatment should be reserved for those who will not consent to operation, a few who are really not fit, and perhaps those who may have to wait for a long time before getting into hospital for their operation To use a pessary even for such patients is not without its drawback, for it may cause ulceration of the vagina and bleeding, if neglected, or is of the wrong size, it may ulcerate through into the rectum or bladder This is an all too common complication which should be preventable if it is remembered that the very patient who needs to wear a pessary may be the one who is not able to look after it or herself properly. Attention must also be paid to the size of the pessary lest too big a one be used My impression is that an ill-fitting pessary may cause ulceration of the adjacent tissues very quickly, that is in only a week or so

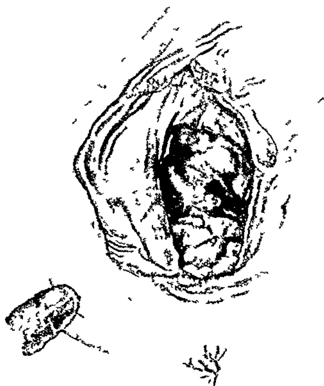


FIG 53 —Drawing showing the prolapsed bladder mucosa whose lower half is ulcerated in a case in which complete destruction of the vesico vaginal septum had occurred 49 years previously

INCONTINENCE OF URINE

This symptom varies from the incessant incontinence of a vesico-vaginal fistula and the stress incontinence of infection, prolapse, and other faults to the urgency of less clearly defined causation

fistula present Any infection in the bladder or adjacent tissues must be diligently sought for and treated energetically There may be a bladder calculus present If the fistula is a vesical fistula then it should be possible to repair it from below, and the principles to follow are the removal of scar tissue, the careful apposition of healthy exposed raw surfaces without tension, and the continuous drainage of the bladder post operatively for one to two weeks

The treatment of a post radium fistula is very much more difficult because the tissue surrounding the fistula is hard, cartilaginous, and relatively avascular Generally speaking, it is a waste of time to try and repair the opening by direct means A better method which may be applicable is to carry out a partial colpocleisis by which the posterior vaginal wall is used for a patch for the opening in the bladder A number of these cases have been reported with very good results

Incontinence on stress

Incontinence on stress is very varied in its aetiology, and many cases are not readily explained The simplest explanation is infection of the urinary tract, particularly cystitis Treatment with sulphonamides is usually very effective for such cases Sulphadimidine 3–4 grammes, followed by 1½–2 grammes, six hourly for five days is satisfactory Some prefer to use full dosage so as to maintain a high blood level of the drug others rely on half this quantity, and certainly their results are good The incontinence may be an overflow incontinence consequent on a partial or complete retention which may result from infection Prolapse of the bladder neck often part of a general prolapse, is another cause of stress incontinence There are a number of intravesical causes for [illegible]
of [illegible]
shc [illegible]
be [illegible] such cases

Treatment of stress incontinence

Many different operations have been devised for the surgical relief of stress incontinence of urine The simplest takes the form of an anterior colporrhaphy with some plication of the [illegible]
hoped that [illegible]
Roberts (1[illegible]
urethral [illegible]
n [illegible]
s [illegible] problems for an occasional case
[illegible] with a perfectly good posterior urethral angle [illegible]
[illegible]

uncertainty remains, the patient placed in the knee chest position, by this method of examination air will enter the vagina and balloon it out, allowing a good view With probe and bladder sound it should then be possible to detect all but the smallest fistula, a few remain elusive, but the search must continue if a fistula is suspected, for even if the opening is so small that it takes only a nylon filament it will still be large enough to allow urine to escape in quantity (Fig 55) Another very simple and helpful test is to place two or three cotton wool swabs loosely in the vagina, and then run some methylene blue or other colouring matter in to the bladder A vulvar pad is worn, and the woman is allowed to walk about for ½ to 1 hour, and is then re-examined If the vaginal swabs are stained blue, there is a vesico-vaginal fistula, if they are stained with uncoloured urine the fistula is ureteric, if the swabs are dry, then the incontinence will be urethral

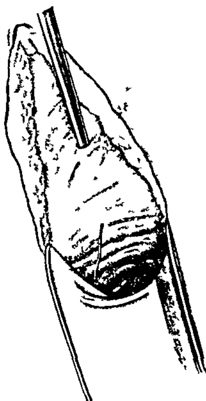


FIG 55—A drawing showing a tiny vesico vaginal fistula, a nylon filament has been passed through the opening

Treatment of urinary fistula

In recent years there have been great strides made in the treatment of urinary fistula in the female, largely as the result of the careful work by Chassar Moir (1954) Most cases can be cured by surgical means, provided care is taken and there is attention to important details As a first step, the patient must be examined carefully to detect the full extent of the fistula lest there be some complication that has at first been overlooked For example, there may be more than one

part The disease is most often seen in women after the menopause, suggesting either that it is related to the changes of old age or to some factor or factors which have operated over a long time

Treatment

Treatment is by wide removal of the vulva and surrounding skin, together with the superficial and deep inguinal and femoral lymph glands and sometimes the iliac glands

This radical operation is an important recent advance in gynaecological surgery, for by it the cure rate in carcinoma of the vulva has been substantially increased It is, however, a formidable operation which old women nevertheless stand wonderfully well The raw area which is left cannot be covered and so heals by granulation, taking about three months Though radiotherapy is said to be ineffective it can on occasion destroy all the carcinoma cells as judged by subsequent operation and careful microscopical examination of the irradiated vulva

Benign lesions of the vulva

The vulva is a very common site for inflammatory and degenerative lesions, and whole books have been written on the subject (Hunt, 1954) The terminology of the various diseases is somewhat confused as the gynaecologists and dermatologists seldom use the same names

If one may use the word "dermatitis" for all diseases showing at some stage redness, swelling or some local fault in the skin then a whole host of diseases may be grouped together, for example ...

intertrigo, lichen sclerosis

Whatever the original cau...

events is not dissimilar Once the skin is damaged, whether by internal or external agents, it is readily irritated further by all manner of substances, especially antiseptics indeed it may well be that anything that comes in contact with the vulva can maintain the 'dermatitis" In such cases, a full history and careful examination are required to elucidate possible aetiological factors, and such as are found must be corrected

Treatment

In those cases in which some definite cause can be found, treatment is straightforward in others in which the cause is elusive treatment is much more difficult The many possible irritating factors include clothing antiseptics, sanitary towels, ill fitting corsets, irritating discharges from the vagina, and incontinence of urine and faeces, to give a few examples ...

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RETENTION OF URINE

Retention of urine is not uncommon in the elderly woman and once again there are many causes Infection as has been mentioned is an important cause Loss of muscle tone perhaps in association with some progressive narrowing and shrinkage of the urethra may explain other cases Occasionally the retention is brought on by some tumour impacted in the pelvis Neurological diseases should also be kept in mind



Fig 56 —Photograph illustrating carcinoma of the vulva

DISEASES OF THE VULVA

Carcinoma

Carcinoma is considered first Vulval irritation and pain indeed any symptom in the elderly woman which is referred to this region however slight it may be demands examination because experience has shown that few symptoms may be admitted with even the most advanced vulval carcinomas When well established carcinoma is easily recognized the ulcer with a raised margin and surrounding induration or the heaped up growth are too well known to pass undetected (Fig 56) It is the early case which presents difficulty Any recent spot which is red and tender and which causes persistent local soreness must be viewed with suspicion The cause of vulval cancer is not known *though local irritation appears to play a*

difficult and unsatisfactory Antibiotics and surgical excision, (which has the advan tage of providing biopsy material) are the main lines cauterization is also practised, but may be more damaging and is certainly no more effective

HORMONAL CHANGES

At the menopause

At the time of the menopause the activity of the ovary wanes and there is a compensatory over activity of the anterior pituitary, which may last for a year or more Surprisingly most women get through this time without inconvenience, but some are much inconvenienced by the 'change' Headaches, irritability, and depression are common enough symptoms Unfortunately, the precise changes that take place at this time are not yet known, for chemical methods of measuring oestrogens are only now being studied to any extent and biological assay is the method available for gonadotrophins

After the menopause

After the menopause the excretion of oestrogen continues and a number of post menopausal disturbances may occur which are not unlike those seen in the younger woman For example post menopausal bleeding following on a benign endometrial hyperplasia may be seen and while this may mean there is a granulosa cell tumour of the ovary, or that there is some dangerous precancerous endometrial change taking place it may also be apparently of less serio ...

... amounts of oestrogen hormone as might be expected she seemed to enjoy good health The skin of her vagina following on the continued stimulation had the vascularity softness and discolouration of that seen in pregnant women

Premature ageing

At the other extreme there are those who are prematurely aged As an example the case of a woman of middle age whose vulva vagina and ...

Inflammation of the vagina

Inflammation of the vagina usually known as senile vaginitis in the post menopausal woman is quite common The absence of ... failure of glycogen ... Doderlein bacil... secretion allow... ... occur The symptoms are soreness of the vulva and vagina and a brownish discharge Diagnosis is often easy

daily washing and drying, and the application of a powder may lead to a great improvement Potassium permanganate 1 6000 *is said to be a useful application*

Leucoplakia

Leucoplakia occupies rather a special place in this section because it is a label given rather more often to a case by the gynaecologist than by the dermatologist Three stages have been described In the first stage, there is thickening of the epithelium and round celled infiltration among deep processes of epithelial cells, in the second, or intermediate stage there is desquamation of the surface layers and degeneration of the deeper structures, in the final or late stage the desquamation and degeneration continues in the widespread fibrosis and the formation of cracks and fissures At this stage a malignant change may develop and for this reason all cases require prolonged and careful watching, in quite a number of cases surgical removal of the diseased skin is required

Hunt maintains that the condition of leucoplakia vulvae, or leucoplakic vulvitis, as described by and as known to the gynaecologists is similar to that known to the dermatologists as lichen sclerosis Furthermore, she maintains that kraurosis vulvae, which some believe to be a still different condition, is no more than a late stage of the same disease



FIG 57—Drawing of a pedunculated urethral caruncle In this type of case *surgical treatment is simple and effective*

Urethral caruncle

Another common lesion at the vulva is the so called urethral caruncle which presents as a tender cherry red area at the external urethral meatus (Fig 57) Nearly all cases are *granulomas of obscure aetiology Diagnosis is as easy as treatment is*

difficult and unsatisfactory Antibiotics and surgical excision, (which has the advantage of providing biopsy material) are the main lines, cauterization is also practised, but may be more damaging and is certainly no more effective

HORMONAL CHANGES

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Premature ageing

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amen ...

Inflammation of the vagina

Inflammation of the vagina, usually known as senile vaginitis in the post-menopausal woman, is quite common The absence of ovarian activity leads to failure of glycogen storage by the vaginal cells and ... in turn means that the Döderlein bac... The absence of this acid ... The symptoms are sore- ... Diagnosis is often easy

because the redness of the vaginitis and the purulent discharge are readily seen Treatment is usually easy Oestrogenic hormone pessaries inserted daily usually leads to a cure in a week or so Stilboestrol and lactic acid pessaries are also used In the old woman, neglected and retained pessaries and other foreign bodies are an important though infrequent cause of discharge

SYMPTOMATOLOGY

Post-menopausal vaginal bleeding

Gynaecology in senescence and senility may also be reviewed from the point of view of symptomatology Post-menopausal vaginal bleeding may properly be considered first because of the fairly high possibility that some serious disease is responsible Carcinoma of the cervix or corpus uteri should be thought of first and excluded by the examination of biopsy material Urethral caruncle, urethral polyp, ulceration of prolapse, senile vaginitis, pyometra, cervical polyp, stilboestrol withdrawal bleeding, benign endometrial polyp and hyperplasia and granulosa-celled ovarian tumours need all be kept in mind It must also be remembered that the bleeding may have come from the bladder rather than the vagina Some cases of bladder papilloma or bladder carcinoma present as post-menopausal bleeding

Oestrin withdrawal bleeding

An important group of cases is that in which post-menopausal bleeding has been caused by the injudicious use of oestrogens either by mouth or by local application If these powerful substances are to be used in elderly women minimal amounts must be given and treatment should be interrupted every two or three weeks, and should not be prolonged

Vaginal discharge

Vaginal discharge if blood-stained may have a similar aetiology, if not blood-stained it should make one think of vaginitis, retained pessaries, and other foreign bodies, and very occasionally slow-growing carcinomas

Pain

Pain is an important symptom after the menopause as it is so often the first warning of some malignant pelvic disease Carcinoma of the ovary may present in this way as may the rapid enlargement of a uterus which is the site of malignant disease Among benign lesions the extrusion or attempted extrusion of a fibroid polyp or the torsion of the pedicle of an ovarian cyst causes pain Pain may arise in some lesion of bladder or bowel Vulval pain always suggests carcinoma

Partial urinary incontinence

Partial urinary incontinence, especially if of short duration, suggests infection or retention with overflow

Complete incontinence

Complete incontinence points to fistula formation Frequency, dysuria, urgency, stress incontinence have a complicated aetiology which may only be clarified by

full examination Retention of urine suggests infection some *pelvic tumour*, or some neurological or senile change

Heaviness or pressure in lower abdomen

A feeling of heaviness or pressure in the lower abdomen has many *causes* Prolapse is a common one but vaginitis also should be kept in mind *Sometimes* there may be a pelvic tumour Other times obesity is responsible for the discomfort

Something coming down may mean a prolapse or a polyp or discharge or occasionally a curtain of abdominal fat (Fig 58) Among other symptoms abdominal enlargement (especially of recent origin) should always be taken seriously

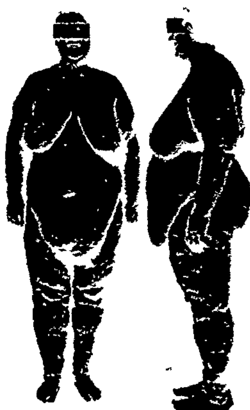


FIG 58—Photograph illustrating the curtain of fat sometimes described as something coming down

TREATMENT

A final few words may be said about the treatment likel to b of advanced yea s A is likely to give

woman A thorough general overhaul is required so that all faults are recognized Especially is this so if surgery is contemplated Malnutrition is probably much commoner than is generally realized Dietetic deficiency over the years may have had a cumulative action which in turn may have been aggravated by progressive limitation of the ability to absorb essential food factors Iron deficiency anaemia and protein deficiency are common, and minor degrees of macrocytic anaemia are not so very rare Vitamin C deficiency is also common especially among those who have been living alone

Excess of carbohydrate in the diet over the years is also common and such patients may show hyperglycaemia and glycosuria, sometimes this is of such a degree that a controlled diet and insulin are required, but other times it is easily controllable by dietary measures alone Obesity is a common and important fault which has to be corrected by appropriate dietetic restriction at the same time as any nutritional defect is corrected It is most gratifying how much benefit will result from correction of obesity in the aged

Bronchitis and other pulmonary afflictions also need attention as they can so gravely prejudice recovery Rest in bed in the warm even temperature of a hospital sometimes confers great benefit Antispasmodics often help Heart disease may also require treatment

Hormone therapy also has a place Thyroid extract may be required if there are signs of myxoedema Oestrogenic hormones possibly combined with androgens may also be indicated

A decision to operate is easy if there is some grave disease that may only be treated in this way The difficulty is when there is no immediate danger to life as for example in cases of genital prolapse, but even in these cases the simplicity and safety of modern anaesthesia and the straightforwardness of modern surgical technique may make the decision easier The situation has been practically reached that, provided a patient is not bed-ridden she is fit for gynaecological surgery With careful pre-operative preparation and gentle yet firm surgery and *very early post-operative ambulation*, often getting the patient up on the day after operation, a successful outcome is to be expected

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CHAPTER 10

ORTHOPAEDIC SURGERY IN THE ELDERLY

CECIL FLEMMING

VALUE OF ORTHOPAEDIC SURGERY IN THE ELDERLY

IN OLD people, bones lose some of their calcium and may break, arteries acquire too much calcium and may become blocked, the joints tend to wear out, losing articular cartilage in the process and producing unnecessary bone Until something is known about preventing these so-called degenerations, the place of orthopaedic surgery will remain limited to aiding repair, mitigating disability and removing useless painful tissue The common gloomy view taken of the value of orthopaedic surgery in old people derives from observations of that frequent injury, the fractured femoral neck This is because for many doctors it is the only condition in which they have seen surgery applied for the relief of a limb disability in an elderly patient The results of treatment, though often good, are sometimes poor, they are poor not because the patient is old but because the anatomy of the hip joint and its blood supply is such that healing is not good. When the femoral neck is broken in children, though it unites, partial necrosis of the head is common, and dislocated hips in young men have a poor prognosis Because fractures of the neck of the femur are common in old people, and because they often fail to unite, it has been argued completely fallaciously, that age is a barrier to repair Some fractures in long bones, notably those in the femur and in the humerus, seem to unite more rapidly in old people than in young and indeed the very presence of the osteophyte in the osteoarthritic joint shows that new tissue formation continues despite advancing years Provided that there is a good blood supply, repair continues throughout life Equally important is the patient's courage and desire to get well, for, without these the long period of treatment often required to restore mobility in limbs is undertaken in vain If, however, after a careful assessment of the mental and bodily resources of a patient, it seems that orthopaedic surgery has something to offer the disabled old person, it should not be withheld only because the patient is old

Over the past few years, surgical operations have become aston[illegible] the chan[illegible]

[illegible] senile prostatic enlargement yet at the same time, the possibility of surgical [illegible] becoming bed ridden fro[illegible] by doctor, relatives or p[illegible] small but until the ment[illegible] [illegible] in the aged is changed, orthopaedic surgery will not be allowed to play the part it can and could do Surgeons

and doctors are curiously reluctant to advise something that may be merely of temporary benefit though it is difficult to see why Much medical care is temporary palliation of discomfort or pain Patients are often more courageous than their relatives and advisers think and very tenacious of their independence I recall a consultation when an elderly lady was pressing me to do something active for her arthritic hip while I was urging her to accommodate her life to her disability. She addressed me sternly saying "Young man, I have a great deal still to do and not much longer to do it in". It was, I thought, a fair reply. It would be wrong to suggest that operations play a big part in the rehabilitation of the old, but it is right to emphasize their place in order to point the lesson that a crippling condition is not to be accepted solely because the patient is old. The problem varies from case to case, examples may help to illustrate the argument.

Case histories

An elderly clergyman had suffered for years from fairly severe rheumatoid arthritis His culminating disability was very severe pain under the heads of the metatarsals in both feet with gross callosities Chiropody and the art of the bootmaker had reached their limits and the resignation of his post was before him Excision of the heads of the second, third and fourth metatarsals through a dorsal incision restored him in a few weeks to an enjoyment of life and work

A very small old lady had severe osteoarthritis of both knees with flexion deformities and partial subluxation, but she was independent and she could just do her shopping She fell and fractured the upper third of one tibia By operation her knee was straightened, the cartilage was removed from the articular surface of tibia and femur and a long Kirschner nail was driven right down the femur, across the joint and through the fracture site Both arthrodesis and fracture united and she was able to get about with a fixed knee and was saved from the alternative, a bed and chair life

Danger of statistical approach

In both these instances an operation was designed to meet the needs of an individual personal disability and it may well be that exactly comparable problems will only seldom be met, but the application of orthopaedic surgery to mitigate an old patient's disability must be more personal than when younger patients are being treated. Their interest in life and their mental grip is astonishingly varied. One of the banes of surgery is the statistical follow-up table which is perhaps of some help in measuring the actual physical survival or death of patients but which seldom gives any picture of happiness or misery. The orthopaedic surgeon who is under the sway of his statistical results avoids the old, left untreated, they do not affect his tables. The following case history indicates the danger to the patient of the statistical approach.

Case histories

An elderly woman suffered from osteoarthritis of both hips, substantially worse in one For the worse hip, a sub trochanteric osteotomy was done, with successful relief from pain, but some years later the second hip became so painful that she was almost bedfast She sought advice again and was told that nothing more could be done and was admitted to a hospital with the intention that she should end her days there

Instead, the painful hip was subjected to operation and an acrylic femoral head was inserted She returned home in three months, content again It is almost certain that in time the acrylic will wear out and that again she will have to enter hospital and that, by statistical assay, the case will prove another failure of the acrylic head operation Until it does, she will be a woman able to live in the happiness of her own home, instead of being a lifelong hospital patient

The importance of being alert to the personal problem of each patient can be illustrated by another example.

An old man sustained a fracture of the tibial shaft which was properly treated by

was therefore examined again and the possibility of plating the fracture was considered

removed, the wound fell apart and the plate was exposed, but the fracture united and he returned happily home with a clean painless ulcer, in the base of which was the plate It was later removed

FRACTURES

In this short section there will be no attempt to survey in detail the management of all the possible fractures which happen to old people It is a curious fact that comparable violence causes bones to break at different places at different periods of age, and therefore certain fractures are commoner in old people than in young, but the guiding rules of treatment are just the same in old people and it is urgent to state once again that no old person should be denied treatment for their fracture on account of age Union will usually take place If it does not or is unlikely to do so, as in some high fractures of the femoral neck, then the appropriate rehabilitation treatment must be given Success is not invariable, but it is wrong not to make the effort Old people do not tolerate long immobilization well, nor can old limbs manoeuvre the weight of heavy plaster casts Metal plates or intramedullary nails, with

of Paris, may be go

would not normally younger patients

Fractures of the femur

Neck

For the treatment of fractures of the neck of the femur it is usually possible to employ some variant of the trifin nail, either the Smith Petersen nail for the transcervical or one of the combinations of

stability to

neck remai

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under their care to be on the look out for this complication It is, however, very often forgotten that the patient nursed sitting up in bed keeps the hips flexed as well as the knees The surgeon is summoned to give an opinion on a patient who has recovered from some period of illness and debility because the knees cannot be straightened Examination quickly shows that the hip cannot be extended, the combined disability is, in my experience, usually beyond correction Theoretically, prolonged skeletal traction might overcome the deformity, but a patient capable from inertia of developing such contractures is almost certainly not in a fit state to undergo severe and prolonged traction Prevention is of the utmost importance It is appreciated by surgeons that a patient, who has an amputation through the thigh, must, from the earliest days, perform extension of the hip actively if a flexion contracture is to be avoided The same principle holds for any elderly patient confined to bed, at almost any cost, the patient must at least once a day (and it need be only once) be flat on the back with the knee and hip extended This precept is practicable in all patients save in those with very severe heart or lung disease and in those so mentally inert that they just curl up on their side all day

Very occasionally it is possible to find a patient who has recovered sufficiently to co-operate in the drastic measures needed to overcome the deformity These include traction through Steinmann pins, manipulations and even sometimes an osteotomy Amputation has at times been considered or requested by doctors, unaware that if there is a flexion contracture of the hip, an artificial limb is unmanageable

It does seem as if there are two kinds of flexion contracture The one is preventable and can be prevented by the simple measures described Other patients, however, are so inert and uncooperative that the most intense care does not suffice to overcome the appearance of an irreversible deformity [illegible]

[illegible] out, if every case is examined carefully, just occasionally one will be found worth trying to save

OSTEOARTHRITIS OF THE HIP

Indications for surgery

Much has been written about the surgical treatment of osteoarthritis of the hip and there is a considerable experience of various methods from which the surgeon may choose The greatest difficulty is to decide when to advise surgery Surgery is admittedly *the last reso*[illegible] of this con- [illegible] the pain and [illegible] are often [illegible] lities that [illegible]

[illegible] surgery

case to be made for undertaking this operation as the first treatment, if the fracture is high and unlikely to join and if the patient is very old The operation is not a good one, however, for fresh fractures and should only be carried out if it is believed that the more orthodox treatment will mean too long a period in bed Old people cannot manage crutches, and it is a hollow victory to achieve union of the fracture at the price of making the patient bedfast It may therefore sometimes be right to insert an acrylic prosthesis in the hope that this method at least may give the patient a chance of getting about again

In an old-standing case, in which the neck has melted away, some stability and movement can be salvaged by doing a modified Whitman reconstruction An acrylic head is pushed vertically down the shaft, which is reduced into the acetabulum, the great trochanter being detached and screwed on lower down the shaft The risk of death as a result of the operation for a fractured femoral neck is very small

Shaft

If the shaft of the femur breaks in an old patient, it is important to investigate the state of the hip joint It will often be found to be the seat of osteoarthritis perhaps with extremely limited movement, the very stiffness of the joint having been responsible for the shaft fracturing In such cases, it is well worth-while aiming at union with an abduction deformity at the site of the fracture, when the fracture unites, the patients may find that they are actually more comfortable and more mobile than they were before the accident

Fractures due to porosis of bones

Despite the frequent incidence of porosis of bones in old age, fractures due to this cause alone are not common except in the vertebral bodies Crush fractures, the result of trivial violence, are common No damage to the spinal cord ensues and treatment should be symptomatic, with no attempt at reduction, and with a period of bed rest ordained by the patient's pain A well-fitting corset, domestic rather than surgical in nature, is a comfort afterwards

Fractures around neck of the humerus

Fractures around the neck of the humerus are fairly common, often angulated and fortunately usually impacted Active use of the elbow, wrist and fingers from the start is urgently required, if these are kept supple, the shoulder is soon used and, though perfect function is seldom regained, no disability of importance remains, the only poor results are those which are the direct outcome of immobilization imposed in the name of treatment

FLEXION CONTRACTURES OF THE KNEES AND HIPS

By contrast with fractures, the management of contractures of the knees is difficult and disappointing In many cases, contractures develop as a complication of confinement to bed for some other cause Even with careful nursing, they are not entirely preventable, but it is important for all doctors who have elderly patients

OSTEOARTHRITIS OF THE KNEE JOINTS

The knees are often the site of the degeneration changes of osteoarthritis All degrees are seen from the relatively acute form in which there is a marked effusion, tenderness over the medial tibial tuberosity at the insertion of the medial ligament up to the chronic form in which there is perhaps calcification in the synovial membrane and subluxation of the joint itself Undue emphasis is perhaps laid on the report of the radiologist who, quite properly, records the radiological changes but whose observations must be related to the clinical signs in the joint Remarkably good function is compatible with advanced radiological changes, or a good deal of pain and disability may be present even though the outline of the bones shows little alteration

Surgical treatment

Surgical treatment, as distinct from that supplied by the agency of physical medicine, is limited The disease is commonly bilateral so that the radical treatment of arthrodesis is usually not applicable I have performed a bilateral arthrodesis, fusing one knee in extension and one in flexion The patient, a woman of remarkable courage, just retained some independent progression but the chance [illegible]

[illegible] corrected position of the [illegible]

plate without the use of external pla[illegible]
to be removed first to allow the tibi[illegible]
required but neither is of great severity

Hydrocortisone

In the more acute form when there is tenderness over the medial tibial tuberosity, the injection into the tender area of 125 milligrams of hydrocortisone may give some measure of relief and allow the more effective performance of those exercises which are the main support of the therapy of this condition

Loose bodies

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w[illegible] the synovia
harm[illegible] Attempts to cut them out do no good and some

HEMIPLEGIA

Surgery [illegible]
people [illegible]
patient [illegible]
lead to s[illegible]
deformity
operation

Arthrodesis and arthroplasty

Arthrodesis is usually a mistake in the old It demands long immobilization afterwards, a healthy spine, healthy knee joints, and a sound opposite hip, these requirements are not often found in the old and therefore some form of arthroplasty is better An excision of the head and neck as described by Girdlestone is a sure method of relieving pain with the production of an unstable false joint The instability is less severe than might be expected and the outcome is a limb which will enable the patient to avoid confinement to bed The operation is not difficult to do nor is it severe on the patient Of recent years, the acrylic head replacement operation, first performed by the Judet brothers, has been widely done though at present in this country rather under a cloud because of its failures It is against all experience to suppose that a foreign material, inserted into the human frame as a moving part, can continue to function without producing irritation and fibrous tissue response The prosthesis does not remain firm in the femur, nor can it be expected to do so, but, for all that, the acrylic head provides for a time a stable and partly mobile hip joint Recovery after the operation is much quicker than after the mould operation of the Smith Petersen type To withhold the operation from an old patient for whom the alternative is a painful bedfast life, solely because *it will not last forever, is wrong The introduction of the operation has* been of very great benefit to many old people and, in the right case, it is the best operation It may be that the metal heads will prove more durable, but it does appear that the plastic head is less irritating, despite the fact that it suffers from some deformation through wear and the material ground away must in itself cause irritation What material is the best will be settled by experience, it is enough to say here that replacement of a diseased femoral head by a prosthesis is a very useful operation

Osteotomy

An osteotomy is the third operation which needs consideration, for it has a well-deserved reputation as a successful method of relieving the disability of an osteoarthritic hip As usually performed, it demands a long period in an extensive plaster afterwards while the bone is uniting, but this period in plaster is one that few old patients can tolerate, and it can be diminished or avoided by using a nail and plate to hold the fragments after division of the bone The operation of osteotomy alone is attractive because it is quick and effective, if internal fixation has to be used it remains effective but is much more difficult and severe on the patient

Conclusion

There is not, nor will there ever be, a universally *applicable operation for* osteoarthritis of the hip There are several excellent operations for those adjudged to need them No patient should be allowed to deteriorate into becoming a cripple from arthritis of one or both hips without surgery being fully and critically considered

elbow cannot be flexed enough to allow the patient to feed himself The list of disabilities is long but, until they have been examined in the light of what they are preventing, and until an effort has been made to see if other means can be found of minimizing the disability, such as altering clothes or furniture, there is no place for operative surgery

It is usually, but not always, unwise to arthodese a joint affected by rheumatoid arthritis It is sometimes tempting to advise the fusion of a knee which has only a limited range of painful movement, but that limited range may be extremely useful if the disease later fixes the hip joint Two joints can be very effectively treated by arthroplasty, the elbow and the inferior radio-ulnar The shoulder joint itself cannot be assisted but there is often painful periarticular thickening, sometimes with involvement of the sub-deltoid bursa, which is greatly relieved by excision of the acromion process

Hands

The hands themselves, though often grossly deformed, seem to retain a usefulness which is quite remarkable The metacarpo phalangeal joints may be actually dislocated by the destruction of the joint capsule and yet retain a range of movement which is valuable If dislocated and stiff, excision of the metacarpal head

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Knees

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degrees from th...

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the foot into an improved position of dorsiflexion The adduction deformity of the hip may also be a considerable disability which is compounded of muscle contracture and fibrosis around the joint, the muscle contracture can be improved by section of the obturator nerve, a simple operation if performed through a suprapubic extraperitoneal approach, but of little value if the joint capsule is grossly shortened It is, however, well worth considering in treating fractures of the femur occurring on the paralysed side, for the muscle spasm makes control of the fragments difficult

The flexion deformity of the wrist can only be treated surgically by an arthrodesis of the wrist joint, an operation which has a place in the treatment of the young spastic, but which seems seldom indicated in the elderly hemiplegic

PAINFUL FEET

The examination of painful feet in old people should always include an assessment of the blood supply, since a poor arterial circulation may itself be the cause of pain and, if there is some other surgical condition, a defective blood supply is a barrier to treatment by operation Within the limits set by the arterial circulation, there are some surgical operations which can add greatly to the relief of symptoms Rigid useless toes, often the site of tender corns, are best amputated The difficulty lies in persuading a reluctant patient to undergo what is regarded as a mutilating operation, but often an old person is intensely grateful after an amputation of all the toes When there is great discomfort from callosities under the metatarsal heads, excision of the metatarsal heads with preservation of the toes beyond may be of great help Painful bunions can usually be relieved of pressure by shoes specially made, treatment of the bunion by aspiration or incision is a mistake, an annoying sinus being often the outcome

The more complicated operations involving arthrodesis have little place, since a long time in plaster after operation is needed More often, a combination of surgery, physical medicine and shoe fitting will meet the case An assessment of what can be done should embrace all possible lines of treatment, so that perhaps a supporting shoe can be worn on a foot made mobile by physiotherapy after an amputation or tenotomy, instead of reliance being placed on the shoemaker alone

RHEUMATOID ARTHRITIS

The treatment of rheumatoid arthritis by general and physical methods is described elsewhere in this book, and in this section mention will be made only of the possibilities of operation in alleviating disability, for, though these possibilities are limited, they should not for that reason be disregarded As the disease affects to a greater or lesser degree many joints, it is necessary to confine attention to the more important disabling factors, and, in trying to decide which of many joints to treat, it is valuable to work out what ordinary activities of living the patient cannot perform On this analysis it can be decided where help is most needed, and whether surgery has something to offer It may be that the fingers, deformed though they may be, seem useful but would be much more useful if the wrist were not flexed or if pronation and supination were free It may be that the

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foot washing and regular pedicure treatment are desirable It is useless advising frail old people to be specially careful about cutting their toe nails and washing their feet, for often they can only reach them with difficulty and sometimes not at all, if they have arthritic knees and hips Someone must do it for them They must be warned against over heating their feet by fires or hot water bottles and the more equable temperature of warm loose fitting stockings is to be preferred Such minor precautions may seem fussy, but they are very important, it has often happened that the precipitating factor leading to a mid thigh amputation has been some minor sepsis in a corn

Apart from the disaster that may follow such preventable minor episodes, a sudden thrombosis in a vessel, already narrowed, may convert a viable limb into one which has to be amputated The episode is often so sudden that an embolus is suspected, but embolism is rare Possibly the thrombosis is an extension of one already existing which blocks a collateral vessel carrying most of the blood The sudden deprivation of blood may lead to to peripheral gangrene or to claudication It is widely believed that claudication means "pain in the calf", in fact the typical pain, produced by movement and relieved immediately by rest, may appear in the feet, or less often in the buttock and thigh Claudication in the feet is important because the symptoms are often wrongly ascribed to some other foot condition, for which treatment is instituted, naturally in vain

From the history, by clinical examination and perhaps with the help of the oscillometer, the state of the arterial supply in the legs can be assessed There is seldom any purpose in arteriography The value of arteriography lies in the information it can give of a localized block, which can be treated by excision and grafting, but in this disease in old people, the degeneration is so widespread that grafting is only very rarely possible After an assessment of the state of the vessels, treatment can be decided

Treatment

In the absence of gross nutritional changes in the skin, the minor but important prophylactic measures already mentioned should be prescribed and supervised It is sometimes suggested that periods of bed rest are beneficial, but in my own experience the benefits of bed rest seem to be theoretical, for I have seen the culminating thrombosis which precipitated gangrene, develop at night or in patients already in bed for some other disease If claudication is the main symptom, the patient can be encouraged to walk until actually stopped by pain

If there are slight nutritional changes in the skin of the toes, or minor sepsis, lumbar ganglionectomy should be considered and almost certainly undertaken Ideally, the second, third and fourth ganglia should be excised, but in practice the excision of as much of the lumbar sympathetic chain as the surgeon can remove proves very effective The operation is not severe, a recent coronary
is the only real reason for no
should not greatly
fact it does *Perhap*

skin infection to heal

PERIPHERAL VASCULAR DISEASE OF THE LEGS

In the elderly, the arteries of the legs are often affected by the degenerative changes of arteriosclerosis The arteries of the upper limb may also degenerate, but, whereas symptoms of a defective blood supply are common in the legs, they are very rare in the arms This predisposition to degeneration which the leg arteries show is comparable to the process of wearing out seen in the joints of the leg, for osteoarthritic changes in the joints of the upper limb are quite uncommon The erect posture, for which the lower limbs were not designed, must be blamed for this difference

Even so, the margin of reserve in the blood supply of the legs is very high, and a substantial reduction in the capacity of the arterial tree is compatible with a leg which works without pain, and which has a well-nourished skin When a thigh amputation is performed on a leg wherein the only evidence of actual tissue death may be confined to part of the big toe, it is not uncommon to find that the only arteries requiring ligature are a much narrowed femoral, and an apparently healthy artery accompanying the great sciatic nerve. These two small trickles have been nearly adequate for the nutrition of the whole leg.

Clinical examination

A routine examination of the arterial circulation in old people shows considerable variations, even though the patient may have no symptoms Clinical examination usually suffices to give all the evidence needed, but, in doubtful cases, the oscillometer gives some help and the readings are valuable for comparison if examinations are made at intervals of weeks or months In normal people, the femoral, popliteal, dorsalis pedis and posterior tibial arteries are palpable, although the popliteal is not always easy to feel In many old people, who have neither symptoms nor signs of defective arterial circulation, there can be felt over the medial femoral condyle an additional vessel, which is part of the anastomosis around the knee If felt, it indicates that the popliteal artery is narrowed, but I have observed a number of old people with this artery palpable, who have so far lived for several years after its presence was first noted, without showing any evidence of an inadequate supply of blood to the leg and foot

The temperature of the skin, as felt by the hand of the examiner, gives supporting evidence The legs must be left exposed long enough to become adapted to an ordinary room temperature If the arterial supply is impaired, there will be felt quite sharply defined zones of cooler skin, depending on the site of the block in the vessels Common sites for these lines of changing temperature are at points about four inches below the knee, about four inches above the ankle and around the base of the big toe

It is then quite clear that a much diminished arterial supply is compatible with comfort and good function, but the tissues are vulnerable if called upon to meet excessive demands Cold is one such stimulus which may prove that the reserve is becoming dangerous, for the addition of arterial spasm may tip the scales beyond the safety point Minor (or major) trauma may demand for its repair more than the arteries can supply Therefore, prophylactically in patients who have been noted as having a marginal blood supply, warm clothing, shoes that fit, careful

foot washing and regular pedicure treatment are desirable It is useless advising frail old people to be specially careful about cutting their toe nails and washing their feet, for often they can only reach them with difficulty and sometimes not at all, if they have arthritic knees and hips Someone must do it for them They must be warned against over heating their feet by fires or hot water bottles and the more equable temperature of warm loose fitting stockings is to be preferred Such minor precautions may seem fussy, but they are very important, it has often happened that the precipitating factor leading to a mid thigh amputation has been some minor sepsis in a corn

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In the absence of gross nutritional changes in the skin, the minor but important prophylactic measures *already* mentioned should be prescribed and supervised It is sometimes *suggested that* periods of bed rest are beneficial but in my own experience the benefits *of* bed rest seem to be theoretical, for I have seen the culminating thrombosis *which* precipitated gangrene develop at night *or in* patients already in bed for some other disease If cl[illegible] *n symptom,*

lu[illegible] inor sepsis, Ideal[illegible] *undertaken* the e[illegible] of the lumbar sympathetic chain as the surgeon [illegible], but in practice proves very *effective* Th[illegible] is the *only real* reason f[illegible] should *not greatly* m[illegible] fact it does Perhaps [illegible]

[illegible] area of skin infection to heal

PERIPHERAL VASCULAR DISEASE OF THE LEGS

In the elderly, the arteries of the legs are often affected by the degenerative changes of arteriosclerosis. The arteries of the upper limb may also degenerate, but, whereas symptoms of a defective blood supply are common in the legs, they are very rare in the arms. This predisposition to degeneration which the leg arteries show is comparable to the process of wearing out seen in the joints of the leg, for osteoarthritic changes in the joints of the upper limb are quite uncommon. The erect posture, for which the lower limbs were not designed, must be blamed for this difference.

Even so, the margin of reserve in the blood supply of the legs is very high, and a substantial reduction in the capacity of the arterial tree is compatible with a leg which works without pain, and which has a well-nourished skin. When a thigh amputation is performed on a leg wherein the only evidence of actual tissue death may be confined to part of the big toe, it is not uncommon to find that the only arteries requiring ligature are a much narrowed femoral, and an apparently healthy artery accompanying the great sciatic nerve. These two small trickles have been nearly adequate for the nutrition of the whole leg.

Clinical examination

A routine examination of the arterial circulation in old people shows considerable variations, even though the patient may have no symptoms. Clinical examination usually suffices to give all the evidence needed, but, in doubtful cases, the oscillometer gives some help and the readings are valuable for comparison if examinations are made at intervals of weeks or months. In normal people, the femoral, popliteal, dorsalis pedis and posterior tibial arteries are palpable, although the popliteal is not always easy to feel. In many old people, who have neither symptoms nor signs of defective arterial circulation, there can be felt over the medial femoral condyle an additional vessel, which is part of the anastomosis around the knee. If felt, it indicates that the popliteal artery is narrowed, but I have observed a number of old people with this artery palpable, who have so far lived for several years after its presence was first noted, without showing any evidence of an inadequate supply of blood to the leg and foot.

The temperature of the skin, as felt by the hand of the examiner, gives supporting evidence. The legs must be left exposed long enough to become adapted to an ordinary room temperature. If the arterial supply is impaired, there will be felt quite sharply defined zones of cooler skin depending on the site of the block in the vessels. Common sites for these lines of changing temperature are at points about four inches below the knee, about four inches above the ankle and around the base of the big toe.

It is then quite clear that a much diminished arterial supply is compatible with comfort and good function, but the tissues are vulnerable if called upon to meet [illegible] demands. Cold is one such stimulus which may prove that the reserve [illegible]

the arteries can supply. Therefore, prophylactically in patients [illegible] noted as having a marginal blood supply, warm clothing, shoes that fit, careful

circulation round the knee joint, but if an aneurysm develops in the popliteal fossa, it acts as a tumour and prevents the dilatation of the collateral vessels Division of the popliteal fascia allows the aneurysm to expand and relieves the collateral vessels

OSTEITIS DEFORMANS (PAGET'S DISEASE)

is most disappointing because the condition is common, and, in some cases, painful and disabling

Paget's original cases were all of sufficient severity to be observed clinically. It is known now, as a result of radiology, that many patients suffer from lesser degrees of the change, which may be confined, and remain confined, to one part of the skeleton In other patients, the disease is widespread and progressive, leading

University College Hospital a record was kept of all those patients in whom osteitis deformans was discovered accidentally in the course of examinations not directed towards the state of the bones, and in the course of 3 years 17 cases were discovered It is certain that there are a good many people leading normal lives

but the incidence of bone sarco

is undoubted, but in any one p

on the other hand, is a very re

loss of the normal demarcation between cortex and medulla, patchy rarefaction and blurring Calcification in the main vessels is commonly seen

few symptoms unless the of the nerves are narrowed Deafness is fairly common In the spine, individual vertebrae may be affected, if the changes are widespread, a stoop develops Paraplegia, due to pressure of the proliferating new bone, is occasionally seen

Biochemical examination shows a high plasma phosphatase figure, but a normal serum calcium and serum phosphorus.

Preliminary tests by injection of the lumbar sympathetic chain to find out whether sympathectomy is likely to be effective are not worth doing, even when there is clear evidence that the lumbar ganglia have been injected successfully, without any increase in skin temperature, it is still possible for the leg to be warmer if the ganglia and the chain are removed

A minor sympathectomy can sometimes tide over an elderly patient with a local septic lesion in the toe, which will not heal because the blood supply is good enough for maintenance, but not sufficient for repair The posterior tibial nerve can be injected just behind the medial malleolus with 2 per cent procaine or Xylocaine The temporary paresis of the foot muscles is unimportant, but there may be a short-lived vasodilation which will promote healing, pain is relieved for a time and the injection can be repeated every other day

For claudication, sympathectomy is of more doubtful value It would be more correct to state that sometimes claudication is improved and sometimes it is not The only way to find out is to do the operation

If claudication in the calf is crippling and sympathectomy has been done with no improvement, subcutaneous tenotomy of the tendo Achillis relieves the patient of his symptoms The operation must be done with a small knife and without a long skin incision, for the blood supply is not adequate for the skin incision to heal

Amputation

For many cases, amputation is the only treatment available Although only the big toe is gangrenous, in nearly every case amputation has to be done through the thigh, for an exiguous blood supply can keep the rest of the leg alive, while being quite insufficient to heal the flaps of an amputation Just occasionally the warmth of the skin below the knee tempts the surgeon to try an amputation through the leg, but disaster follows more often than success

Successful rehabilitation and the useful enjoyment of an artificial limb depend on rapid healing of the stump, active exercises in bed as soon as possible and a patient of high courage Physician and surgeon together have the responsibility of seeing that the courage of the patient is not sapped by prolonged and useless palliative treatment, after it is quite apparent that the leg has got to come off It is not kindness to kill the pain of incipient gangrene with drugs for weeks if it is certain that amputation is going to be required It requires confidence and experience to advise a patient who has only severe pain in the big toe that he must lose his leg through the thigh, but the relief of pain and restoration of well-being which follow are so great that doctors, once they have made up their minds, should not delay in telling the patient

There are occasionally indications that a low amputation of the toes through the foot may be successful, usually in diabetics, but such opportunities are rare

POPLITEAL ANEURYSM

[illegible] than syphilis and [illegible] in the popliteal [illegible] inappropriate to discuss the treatment of popliteal aneurysms here, but sometimes a relatively simple operation gives temporary relief, even for years There is a good collateral

CHAPTER 11

ANAESTHESIA FOR THE ELDERLY

FRANKIS T. EVANS

GENERAL CONDITION OF ELDERLY PATIENTS

OLD AGE in itself is no bar to surgery, but the altered physiology and the diseases which tend to beset the elderly call for care in the choice of anaesthesia Advancing years bring changes in the body, both in respect of anatomy and physiology. Ossification can occur in the vertebral column and in the interspinous ligaments thus limiting movement Limbs become less mobile, and even the thoracic cage itself may become fixed so that the vital capacity is lessened Diminished energy and limitation of locomotion tend to restrict the amount of daily exercise taken, and as the individual becomes more sedentary he tends to put on weight and may [illegible]

[illegible] unwisely so that there may be very real vitamin lack. Consequently if surgery be contemplated it is wise to get the patient into hospital so that his general condition may be adequately evaluated Pre-operative preparation is essential for the correction of any anaemia, avitaminosis, and possible electrolytic imbalance. The actual operation to be performed must be decided after considering the patient as a whole, and it must be remembered that time is of paramount importance when operating upon old people The post-operative period also must be given careful consideration Not only must supportive therapy and blood replacement be given, but shock must be anticipated and adequate means of resuscitation must be at hand As Hewer (1954) has pointed out, it is during the post-operative period that minor disabilities can assume major proportions and become a threat to life itself, For example, an old gentleman may suddenly get retention of urine and need repeated cath[illegible]

ha [illegible]
In [illegible] may be expected to occur in the body with advancing years

Skeletal structure

The bones become [illegible]

[illegible] the production of androgens and

In some patients, confinement to bed for some intercurrent condition, such as a fracture or heart disease, leads to an excess of calcium in the blood, which is beyond the capacity of the kidney to excrete so that calculi may form This complication is not common but is a reason for selecting a method of treatment demanding as short a period in bed as possible

Fractures

Long bones affected by osteitis deformans break easily with inadequate violence The femur and tibia are the bones mostly involved. Sometimes the film of an unbroken femur shows a number of small cracks, which are incomplete, the final fracture which brings the patient to the ground is the extension of one of these cracks through the whole shaft The other site of fracture is at the point of junction of an area of diseased bone and normal bone as yet unaffected The first type of fracture occurs in the brittle bone in which the process has ended or is dying out, the second in the active stage of the disease Union usually follows, slowly in the brittle bone, rapidly in the actively involved bone The process of calcification of the callus in this second type is more rapid than in normal bone, though the time taken for final consolidation is no shorter A complication of the management of these fractures is that, during recumbency, there may be an excessive calcium output liable to over-tax the kidney and cause stones to form Treatment which may enable the patient to be kept mobile is important and the use of a plate to hold the fragments is sometimes advocated Unfortunately the consistency of the bone makes it unsuitable for drills and screws, which sometimes make the bone splinter There is in these cases a clear indication for considering the use of an intramedullary nail The only difficulty derives from the curve of the bone which makes it impossible to pass a nail down the shaft If treatment by operation is impossible, standard conservative methods must be used

Arthritis

If the pelvic bones are the site of the disease, the acetabulum softens and deepens, and a painful arthritis of the hip joint is the sequel If this becomes so disabling that surgery must be considered, the patient can be relieved by excision of the head and neck of the femur The lumbar and sacro-iliac joints can become very painful if the surrounding bone is affected A surgical belt and steels can give very considerable relief

Pain in the bones

Usually the pain is controllable by simple drugs, but sometimes pain at night is a severe burden Radiotherapy relieves some, but not all, of these patients Direct operation to gutter or decompress the bone has been advocated, but can seldom be warranted

BIBLIOGRAPHY AND REFERENCES

— y of the Hip Joint In *Modern Trends*
terworth
Femur" In *Modern Trends in Ortho*

would be wise to assume that there is some degree of left heart failure and choose his anaesthetic accordingly. Hypertension *per se* is not a contra-indication to anaesthesia, provided the diastolic pressure is low. The writer finds that most hypertensives stand operation well provided that blood be replaced and that the systolic blood pressure be prevented from dropping below 100 millimetres of mercury; this is an arbitrary figure and must not be taken too literally, because so much depends upon the cardiac reserve and the elasticity of the vascular bed.

Effect of carotid sinus pressure

La Place (1949) mentions that the aged heart accelerates less in response to atropine and slows less in response to carotid pressure. Greeley (1953), however, feels that many of the deaths on the table may have been due to a hyperactive carotid sinus reflex. There is reason for belief that many hypertensive patients have increased laryngeal sensitivity of vagal origin; which is quite frequently demonstrated by the occurrence of laryngeal spasm when thiopentone is used Indeed, Lorhan (1955) emphasizes that any geriatric patient who gives a

cardiographic and blood pressure tracings, before subjecting them to anaesthesia

Cardiac murmurs

Cardiac murmurs are frequently audible in the elderly and need be of no really serious significance provided that the heart is apparently otherwise sound No comment need be made to the patient about the presence of a murmur lest he become apprehensive of his condition and worry needlessly. A history of past coronary thromb

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Case history.—This is illustrated by a patient who had had

Premature beats

Premature beats are frequently found in the elderly and need be of no serious significance If they do not disappear on exer

of significance and suggest m

premature beats are the forer

viewed today from the point of view of administering an anaesthetic with such trepidation as it has been in the past. Paroxysmal ventricular tachycardia must be

oestrogens (Albright, 1947) As mentioned above, ossification may occur in the intervertebral ligaments, and osteoarthritis with vertebral fusion is common Osteoarthritis, diminished joint movement, and fixation of the sternum and thoracic cage can occur all too frequently These changes diminish vital capacity and can materially hinder early ambulation, and even make for a difficult surgical approach

Respiratory system

As a result of the general reduction in elasticity the lungs and tracheo-bronchial tree become fibrosed, and this leads to a further reduction in vital capacity According to Lorhan (1955) the lung fields are reduced by 25 per cent as a result of atrophy Indeed, he states that one-third of the lungs in the aged show emphysematous changes Emphysema is characterized by a barrel-shaped chest, which is fixed in the inspiratory position Thus the thoracic part of the inspiratory effort is lacking, and this, combined with loss of elasticity of the lungs to aid in expiration, leads to the accumulation of air in the air sacs, which themselves are diminished in number Thus there is a rise of residual air from the normal amount of 35–40 per cent to as much as 70–80 per cent of the total capacity (Lorhan, 1955)

Emphysema is an extremely serious condition, for not only does it threaten the patient's post-operative progress, but, due to dyspnoea and tachypnoea makes the surgical abdominal approach extremely difficult The abdominal muscles are called into action to assist respiration and consequently abdominal quietude and *muscular relaxation are more difficult to obtain Pulmonary fibrosis is present in* many old people, and this, coupled with emphysema, leads to hypertrophy of the right ventricle and eventually to right heart failure Chronic anoxia and carbon dioxide retention are seen in cor pulmonale, a condition which the anaesthetist finds most trying to deal with

Cardiovascular system

The heart undergoes a slow degeneration with increasing age and the writer agrees with Dillon (1947) that patients over 70 years of age should be considered to have some cardiac impairment even though there may be no demonstrable cardiac disease Cohn (1949) has described the changes in the cardiovascular system likely to be found in old age as follows (1) changes in the coronary arteries, (2) increase in subpericardial fat, (3) endothelial thickening, (4) rigidity and leaking of the valves, (5) changes in the muscle fibres and their nuclei, (6) changes in elastic tissue of the aorta, ventricles and auricles (7) decrease in heart rate, (8) changes in rhythm such as the occurrence of premature systoles and possibly paroxysmal auricular fibrillation, (9) diminished capacity of the heart to use oxygen, (10) decreased sensitivity of the heart carotid sinus nerve impulses, and (11) changes in the peripheral arteries, arterioles and capillary bed

Hypertension, which is all too frequently present, leads to cardiac hypertrophy, [illegible] aortic stenosis and mitral leak and to loss of elasticity of the arteries themselves The heart is called on to do more work until eventually signs of left heart failure occur *If there are* audible crepitations in the lungs of elderly patients the anaesthetist

not so tenacious and consequently he is not so likely to fight for recovery as the younger man for consciously or unconsciously the bonds are loosening

FACTORS INFLUENCING THE CHOICE OF ANAESTHESIA

It is hoped that the foregoing has made it clear that the choice of anaesthesia and its problems are not those of mere old age except insofar as less is required to produce a particular effect and more care must be given to the question of excretion rate It is the diseases which so commonly accompany old age which produce the biggest problems

A typical example occurred recently in a woman of 83 years of age who was also grossly fat She had an enormous pro identia which was successfully treated by vaginal hysterectomy and repa r One hour before the operation she was given an injection of pethidine 50 milligrams and atropine 1/100 grain followed by chlorpromazine 12 milligrams promethazine 25 milligrams and pethid ne 25 milligrams intravenously in the anaesthet c room and h ne [illegible]

This case is mentioned because it illustrates some of the problems facing the *anaesthetist* The patient was using her abdominal muscles for ordinary *respiration* but if a spinal analgesic had been used it would have been necessary to produce a block to a height of D6 The consequent fall of systolic blood pressure would have been too profound for safety and therefore it was decided to use the caudal approach The lumbar epidural approach was ruled out anyhow as a res lt of [illegible]

[illegible] tubocurarine chloride or other relaxant been used to stop respiration entirely there would have been the necessity for passing an endo tracheal tube to guarantee a clear *airway* [illegible]
case of a chronic bronchitic is not a *wise* [illegible]
would have been given open *chloroform* [illegible]
catheter inside the airway delivering oxygen [illegible]

Particular points to be considered

In choosing *the* anaesthetic the writer feels that the following *should be* considered

(1) Infection and [illegible]
(2) State c[illegible]
(3) Digest[illegible]
(4) Excret[illegible] [illegible] damage
(5) Dehydration
(6) Mental outlook
(7) Operation to be *performed*

considered with great caution as it is often associated with severe coronary disease True sinus bradycardia is fortunately rare and patients with this condition may die suddenly during the induction of anaesthesia.

Gastro-intestinal system

Mucosal atrophy and wasting of the muscle in the wall of the gut impair digestion The gastric juices are less in amount and some degree of achlorhydria may be present. If the patient is vomiting there will almost certainly be some degree of dehydration and electrolytic imbalance. Dietary indiscretions are not so frequent as wrong feeding and insistence on one item of diet. For example, it was discovered that one old gentleman had eaten nothing but bread and butter and drunk tea for months on end As a result of wrong feeding and poor absorption there may be an iron deficiency anaemia to deal with There is, too, a deficiency of vitamins of the B complex and ascorbic acid All this can be made worse if the patient has ill-fitting dentures and is consequently unable to chew properly Finally, although liver function is usually unimpaired, there is diminished glucose tolerance and may be true diabetes

Genito-urinary system

The renal capacity is decreased as shown by the urea clearance test The glomeruli are decreased in number and there is increase of connective tissue between the apices of the pyramids It has been shown that the glomerular filtration rate, effective plasma flow and tubular re-absorption rates are decreased (Shock and Yiengst, 1950)

Tubular function is damaged to a greater extent than glomerular function, so that excretion is impaired Retention of nitrogen is more likely in the elderly because of the impaired excretory capacity of the tubules

However, the renal impairment of old age is largely overshadowed by the insidious damage due to progressive prostatic enlargement causing obstruction and back pressure Retention of urine requires catheterization for its relief, and this may start infection so that the patient may present himself with a pyelo-nephritis, and an atonic bladder complicating an already damaged kidney These patients must be approached with great care from the aspect of anaesthesia and it must be remembered that drug excretion may be much delayed The method of anaesthesia, too, should be one which will put as little added strain on the kidney as possible

Mental outlook

The effect of the psyche upon the body is incalculable, and as one progresses through this earthly life it is gradually realized that faith does indeed move mountains For those who have attained to this happy knowledge there comes a calm and philosophical acceptance of what each day brings forth, whether it be good or ill, for all is experience It is these people who withstand surgery and anaesthesia well This state of mind is quite different from that in cerebral sclerosis, for with the former there is intelligent co-operation, whereas with the latter there is mere indifference and later mental confusion The former attitude of mind means peaceful easy induction, smooth maintenance, and placid recovery There is, however, another facet to this mental outlook The individual's hold on the body is

PRE OPERATIVE PREPARATION

Routine examination enables the anaesthetist to form a very shrewd idea of his patient's condition and inspection alone can prove most informative The patient's colour the presence of engorged neck veins, the rate and character of the respiration are all revealing even before a question has been asked However, certain examinations are necessary The blood examination will reveal anaemia, an x ray picture of the chest will reveal the size of the heart the state of the aorta and the condition of the lungs

Dehydration and electrolyte imbalance

Dehydration and electrolyte imbalance must be corrected preferably before operation and such conditions as diabetes should be stabilized before surgery is undertaken If however the operation is of an emergency nature glucose should be given intravenously and soluble insulin hypodermically to counteract the ketosis present It is well to estimate whether there is lessened blood volume and decreased plasma protein

The daily urinary output must be measured and routine examination carried out, the blood urea can be a very valuable help in assessing a patient's condition It is important to differentiate the dry tongue of uraemia from that of water and salt depletion The increased viscosity of the blood which occurs in dehydration has a tendency to cause stasis and thrombosis

Electrocardiographic examination

Those patients in whom cardiac incompetence is suspected should have an electrocardiographic examination, incidentally, potassium deficiency may be shown by the depression of the S T segments and flattening of the T waves

Anaemia

Blood transfusion should be given to correct anaemia if the haemoglobin is under 70 per cent One or two pints should be given to correct this

Diet

Diet should be adequate and rich [illegible]
aemia leads to c [illegible]

[illegible] as amino acids intravenously if the oral route is not possible

Vitamin deficiency

Vitamin deficiency is common [illegible]
tender muscles and dry [illegible]
be given orally as aneu [illegible]
intravenously (Benerva [illegible] ascorbic acid, 500 milligrams) It is preferably given in the morning for patients may find difficulty in getting to sleep if given in the late afternoon Aneurine is essential in carbohydrate metabolism and

Therefore, in selecting the anaesthetic to be used the anaesthetist should choose that method which will cause the least disturbance of the patient's metabolism The advisability of the use of local or regional block must be given due consideration particularly in those patients who are diabetics Ether should be avoided in those patients who are bronchitic or where shock is anticipated, for Zweifach and Hershey (1949) have shown that there is very little vaso-excitor material present under ether anaesthesia and this is rapidly replaced with vasodepressor material They found on examining the omentum of dogs under ether subjected to repeated haemorrhage that the larger arteries were only moderately constricted, and the arterioles were not constricted at all at or near to the terminal period Although less blood was circulating through the capillaries none was actually closed and as a result the blood flow in the collecting venules became sluggish particularly at blood pressures of 60 – 70 millimetres of mercury This picture contrasts with the active vasoconstriction of arteries and arterioles and the brisk venular circulation when cyclopropane is used This experimental work is paralleled by the figures mentioned by Mary Karp (1947) who quotes a mortality of 31 3 per cent with ethylene ether, yet when cyclopropane was used the mortality was nil Although all these patients had some form of cardiac disease, and although statistics must always be considered with caution, these figures do tend to incriminate ether, that old and valued friend

There are some who favour the wide use of spinal analgesia, but the writer feels that it should be used with caution and agrees with Dillon (1947) that the level of analgesia should always be kept below the 10th dorsal segment and that the blood pressure should be kept supported with suitable pressor drugs The dose of the spinal analgesic should always be kept small, in fact 100 milligrams of procaine is regarded as the maximum dose Gross hypertension and anaemia are contra-indications Dillon (1949) used spinal analgesia in 507 (or 55 7 per cent) of his cases, and quotes a mortality of 22 cases (or 4 3 per cent), yet there was but one death on the table Incidentally in the same table he quotes a mortality with ether of 5 cases (or 18 5 per cent) This must not be construed as a recommendation by *the present writer for the use of spinal methods as opposed to ether*

It has been well said that the actual method counts for comparatively little, but that it is the man holding the syringe who counts Experience is nine-tenths of the battle, but in dealing with old people the following are essential

(1) Adequate replacement of blood loss during the operation
(2) Adequate oxygenation, no anoxia can be allowed under any circumstances
(3) Adequate pre-operative preparation
(4) Minimal premedication
(5) Minimal post-operative sedation
(6) Adequate pulmonary ventilation post-operatively
(7) Early ambulation if possible

It must be remembered that the elderly require smaller doses of drugs and that there is often a slowed circulation time so that intravenous injections take materially longer to manifest their effect Neglect of this precaution can lead to sudden death when thiopentone is being used

anaesthetic risk. Nevertheless it must be admitted

anaesthesia giving rapid recovery.

Antibiotics

The introduction of the antibiotics has proved lifesaving; indeed, in geriatric anaesthesia the word "miraculous" is not out of place.

Some years ago the writer anaesthetized a lady of 75 years of age for the cure of a hiatus hernia. This had to be performed through the thorax under endotracheal anaesthesia. Induction was with thiopentone and gallamine triethiodide, after intubation maintenance was with nitrous oxide and oxygen (30 per cent). Minimal fractional repeat doses of thiopentone and gallamine were administered as necessary. The operation was uneventful, the lung was fully expanded at the conclusion, and the patient was returned to her room in excellent condition and was quickly round. Twenty-

temperature settled, the lung expanded completely and the patient went home a new woman. Had there not been a suitable antibiotic this patient would almost certainly have died.

Premedication

Morphine

Morphine, if used at all, must be given in very reduced amounts, for the geriatric patient is apt to react to it badly. It acts as a strong central depressant and its action on the respiratory centre can be very profound. The cardiac centre, too, may be depressed and a fall of 20 millimetres of mercury in systolic blood pressure is not uncommon following its use. Its stimulant action upon the vomiting centre is only too frequent (25 per cent). The dose recommended by injection is ⅛ grain (8 milligrams) and should never exceed ⅙ grain (10 milligrams). Admittedly there are some very active and vigorous septuagenarians, but these are exceptional and even for them it is not recommended to exceed a dose of ⅙ grain of morphine. This may be combined with atropine, 1/100 grain, with advantage. Scopolamine on the other hand is best avoided altogether. It is true it has a drying action like atropine but it is apt to depress respiration further and also may cause mental confusion post-operatively, particularly in prostatic patients. It is the writer's practice to avoid morphine

drug

much

50 –

average dose being 15 milligrams, and it is

vitamin C is essential for wound healing The oral administration of 1 gramme of ascorbic acid, 30 milligrams of aneurine, 100 milligrams of nicotinamide and 5 milligrams of riboflavine for some days before surgery will prove adequate to counteract a major vitamin deficiency (Lorhan, 1955)

Heart disease

Heart disease need be no contra-indication to surgery, but if a patient presents in heart failure and operation can be delayed for four or five hours digitalization can be successful It is, however, important to find out if any digitalis has been given during the past fortnight, for in this case *intravenous* digoxin is absolutely contra-indicated

Low grade failure

If low grade failure be present digoxin, 1 5 milligram, should be given orally, followed by 0 5 milligram four hours later just before operation, if it can be delayed no longer This method should give adequate digitalization lasting well into the post-operative period

Gross failure

If there is gross failure with or without auricular fibrillation and operation is really urgent digoxin, 1 milligram, may be given intravenously provided none has been given previously during the past fourteen days

Quinidine

Quinidine has no place in cardiac failure, but should be given if there are frequent ectopic beats and there is reason to believe that the patient will pass into auricular fibrillation A test dose of two grains should be given orally to find out if the patient is sensitive to the drug If all is well then 5 grains by mouth two-hourly for three to four doses should be given If the patient is sensitive to quinidine, procaine amide may be used instead A rough but effective evaluation of the cardiac state and pulmonary reserve can be made by asking the patient to hold his breath If the patient can do this for 35 seconds he can be considered to be normal

Chronic pulmonary infection and bronchiectasis

Chronic pulmonary infection should be treated with the antibiotic to which the organisms are demonstrably sensitive Bronchiectasis requires postural drainage, but both conditions will benefit from the treatment given by a good physiotherapist Breathing exercises, if necessary after the inhalation of isoprenaline, are of the greatest value

Operative mortality

The foregoing may sound somewhat formidable for the preparation of the geriatric patient for surgery, yet in little over a decade the percentage of patients operated on after 70 years of age has doubled (Dillon, 1947) However, Turville and Dripps (1948) state that of 1,064 patients operated upon over the age of 70 the overall mortality was 4 9 per cent and of this number 3 4 per cent had atelectasis or pneumonia as a complication and pulmonary embolism occurred in 1 per cent

Baird (1943) quotes 461 patients the youngest of whom was 70 years of age and the oldest 93 years of age The mortality here per 100 patients was 17 1 per cent, but per 100 anaesthetics, 11 7 per cent It was noted that the mortality was greater in those who were over 80 years of age than in those between 70 and 80 years of age Old people withstand surgery remarkably well provided they are properly prepared and soundly evaluated as an anaesthetic risk Nevertheless it must be remembered that certain precautions must be taken, for shock comes on early and surgery must not last more than an hour and a half at most Modern anaesthesia, utilizing the relaxants enables satisfactory abdominal relaxation to be obtained with light anaesthesia giving rapid recovery

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temperature [illegible]
woman. Had [illegible]
have died

Premedication

Morphine

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be depressed and a [illegible]
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operatively [illegible]
morphi[illegible]
drug is [illegible]
much r[illegible]
[illegible] It is used by the writer in a dosage of 50 – 100 milligrams by *injection*, an average dose being 75 milligrams, and it is [illegible]

combined with atropine, 1/150 grain This combination is given 45 minutes to one hour before operation If the patient is very frail it is wise to avoid all depressant premedication entirely and to give atropine, *1/100 grain only, some thirty minutes* pre-operatively Barbiturates are not tolerated well by elderly people and excretion may be delayed

Lytic cocktail of Laborit

The writer has used the lytic cocktail of Laborit with success in a somewhat modified form as a prelude to the use of a regional block. The dose used is chlorpromazine (Largactil), 12·5 milligrams, promethazine (Phenergan), 25 milligrams, and pethidine (Demerol), 25 milligrams This is used diluted with saline to 20 millilitres and is given intravenously very slowly some fifteen minutes before the epidural or caudal block is due to be given Five millilitres of the mixture are injected over a period of 30 seconds, then a pause is made for 45 seconds. After this time has elapsed a further 3 millilitres are injected in like manner and further injections of similar dosage are given until the eyelids just begin to droop and the mouth and cheeks begin to puff out on expiration This is the moment to change syringes, and a dose of 150–300 milligrams of thiopentone may be given according to the way in *which the patient has reacted to the primary mixture At this stage the* caudal or epidural block may be performed and there should be little or no response to the needle prick The blood pressure may fall some 20 or 30 millimetres of mercury as a result of this procedure, and blood pressure readings should always be taken as a routine Inhalation anaesthesia may be used instead of regional block and in this case succinylcholine chloride (Scoline), 30–50 milligrams, is given intravenously for intubation Nitrous-oxide and oxygen (30 per cent) is used for maintenance, abdominal relaxation, if required, may be obtained by *d* tubocurarine chloride, 15 milligrams, intravenously This is usually adequate for the frail people, but sometimes further increments (3–5 milligrams) of tubocurarine are required This suffices for a partial gastrectomy and avoids the annoying diaphragmatic "bucking" The effect of this dose of chlorpromazine lasts for an hour or perhaps a little more Patients are co-operative after the operation and need less morphine, they do not require the first injection so soon One of my colleagues uses the chlorpromazine mixture alone if post-operative bronchoscopy is required and finds that the patients are more co-operative under these circumstances

Premedication for shocked patients

Premedication for the shocked patient should consist solely of atropine which may be given intravenously Morphine should never be given hypodermically in this state because it is not absorbed, and when the blood pressure rises after transfusion absorption of the morphine now occurs only to cause a further fall of blood pressure and central depression

Finally, it must be stressed that with frail patients or when in doubt give atropine only as premedication

MANAGEMENT DURING OPERATION

As mentioned above, anoxia must be *avoided, and it is wise to administer oxygen* as nitrous-oxide and oxygen (30 per cent by volume) or even as a flow of oxygen

close to the mouth The administration of cyclopropane in a closed circuit is extremely useful as there is a high oxygen content in the respired gases *However*, it must be remembered that adequate exchange must be maintained otherwise there can occur serious carbon dioxide retention even though the patient be pink in colour

Blood replacement

Blood replacement is essential in major surgery, and it must be given at the time of operation so as to forestall the likelihood of haemorrhagic shock For example in perineo abdominal excision of the rectum the blood should be going in to the patient's venous circulation at the commencement of the operation if it be of the synchronous type, and should keep pace with the blood loss If the operation is of the Gabriel type (perineo abdominal) blood should commence before the perineal dissection is begun

Blood pressure

The blood pressure should not be allowed to remain below 70 millimetres of mercury under any circumstances Spinal block is apt to creep upwards and to cause a profound fall of blood pressure so that pressor drugs such as methylamphetamine (Methedrine) should be at hand The dose need *not* be large, and 5 milligrams intravenously with 5 milligrams intramuscularly will usually raise the pressure to 90 or 100 millimetres of mercury and maintain it at that figure for the rest of the operation

Tracheal toilet

Tracheal toilet is more likely to be needed in the elderly than *in younger patients*, and should be performed at the end of the operation by suction through an endotrocheal tube or bronchoscope

Endotracheal intubation

The need for endotracheal intubation is debatable, and the writer is against its indiscriminate use *An endotracheal* tube is an irritant and can cause trauma to the trachea very easily however gentle the anaesthetist may be Intubation is best avoided except *under the* following circumstances (1) When there is risk of vomitus *entering the trachea* (2) if controlled respiration is contemplated, or (3) if it is *necessary for the* surgical approach

ANAESTHETICS AVAILABLE

Diethyl *ether*

Diethyl ether that h
real friend
diminution
substance
shock und
ether for it causes a *steady deterioration* of the circulatory system with a *fall in* systolic blood pressure when used for deep anaesthesia It causes a *big rise of blood*

sugar, which has been held to be due to mobilization of glycogen due to sympathetic stimulation. It is toxic to the liver and kidneys, is somewhat irritant to inhale, and is a frequent cause of post operative vomiting. Yet, ether is still one of the safest anaesthetics we possess and it is difficult for the inexperienced to kill the patient on the table. It *is* possible to use ether as an adjuvant to nitrous oxide and oxygen an etherized nitrous oxide and oxygen as opposed to nitrous oxide and oxygen ether, where the gases are merely a vehicle for ether vapour. With the former the patient wakes up immediately, not so with the latter. Very small quantities of ether used for a matter of minutes only are not likely to cause serious trouble but it should not be used in the presence of haemorrhagic shock or given to diabetics or those with bronchitis or emphysema if it can be possibly avoided. Even so the elderly patient stands more chance of recovery if given ether than if given a spinal block by an anaesthetist inexperienced in the method.

Chloroform

It was always said that old people took chloroform well, and so they did if given carefully and in moderation. In days gone by if inhalation anaesthesia was required for a plethoric elderly bronchitic chloroform was given by the open method with added oxygen. This was the writer's method of choice for it was the only way apart from spinal block of obtaining a reasonably quiet abdomen. Chloroform should never be given to those who have a low blood sugar and whose liver has been depleted of glycogen or to those with severe liver damage. It is directly toxic to the heart muscle, and should never be used in heart failure or for long anaesthesia. Its only justifiable use nowadays perhaps is in cases of acute oedema of the larynx where local analgesia is impracticable, or to help settle a difficult coughing patient. A second administration of chloroform must never be given within twenty four hours of the first or "chloroform poisoning" is likely to result.

Trichloroethylene

Trichloroethylene, introduced by Langton Hewer, is a very useful adjuvant to nitrous oxide oxygen, but it must not be used to attempt abdominal muscular relaxation or signs of over dosage may occur, namely, tachypnoea and cardiac irregularities. Patients are more prone to vomit if this has been used, than if nitrous oxide and oxygen alone was the anaesthetic.

Cyclopropane

Cyclopropane has proved most useful for administration to the elderly, for it has the advantage of being rapid in action and recovery is also quick, the only drawback being that it is explosive and must be used in a closed circuit. Gas tight apposition of the facepiece is not easy to attain in old people who are frequently edentulous. This can be overcome by using a Thornton's mouth prop which fills out the cheeks, or by using an endotracheal cuffed tube. Cyclopropane is apt to cause nausea, but against this can be put the fact that there is always a high oxygen content in the inhaled gases and that there is a large amount of

retention due to inadequate ventilation, or the so-called cyclopropane shock may supervene when the anaesthesia is terminated Cyclopropane is a most useful anaesthetic for the geriatric patient and its use in abdominal surgery coupled with the judicious intravenous injection of a relaxant has proved of the greatest benefit Baird (1943) found that there were more complications involving the respiratory system after cyclopropane than after spinal block in his series On the other hand the largest percentage of circulatory complications followed spinal analgesia

Nitrous oxide and oxygen

[illegible] –30 per cent,
thiopentone
The primary

dose of pethidine should not exceed 15–20 milligrams, and it is wise to allow some minutes to elapse before further increments are given The writer considers that a total dose of intravenous pethidine for any one operation should not exceed 50 milligrams Frail patients would not require as much as this and the anaesthetist must always be guided by its effect on the respiratory centre Too much pethidine can make it difficult to arouse elderly patients for many hours post operatively

Relaxants

The relaxants have their place in geriatrics, but they are not needed in quite the same quantity as in younger people This is understandable and is probably due to the fact that old people have less blood volume and extra-cellular fluid The relaxant [illegible]

[illegible] cinylcholine-chloride (Scoline) or decamethonium iodide (Syncurine) There is however some evidence for believing that a depolarizer, if used in fairly large amounts can act by competitive inhibition This is of importance for there are occasions when a patient who has been given repeated doses of a depolarizer is very slow to return to adequate respiration These patients frequently react to neostigmine after a preliminary injection of atropine

Action of relaxants

This is not the place to elaborate the action of the relaxants for there is sufficient material for a whole chapter on this subject Suffice it to note that when a motor impulse arrives at the end plate acetylcholine is liberated which enables the muscle end plate to be depolarized with generation of the action potential causing contraction of muscle [illegible]
chol ne by chol [illegible]

[illegible] se, thus tending
used as an antidot [illegible] depolarizers for it tends to increase their action

d-Tubocurarine chloride, which acts by competitive inhibition, prevents depolarization occurring by blocking the response to acetylcholine This substance is formed but is prevented from exerting its action Neostigmine and Tensilon antagonize this effect by preventing the formation of cholinesterase, with the result that acetylcholine tends to accumulate in overwhelming amounts and thus setting off the contraction sequence Occasionally people are found whose serum or pseudo-cholinesterase level is very low, and if succinylcholine is given to them they may be reluctant to recommence respiration. A transfusion of fresh whole blood which is rich in pseudo-cholinesterase will usually provide the necessary stimulus for respiration to begin again The relaxants can also be put into four distinct groups in terms of duration of action There are those which are ultra short acting such as succinyl-dicholine (Scoline) which may be used to render intubation easy, gallamine triethiodide (Flaxedil) of medium duration, *d*-tubocurarine chloride which is the standard and laudexium methyl sulphate (Laudolissen) which last much longer than any

Dosages

The relaxants are not anaesthetics but merely adjuvants to produce relaxation of muscles Thus it is possible by means of them to maintain a patient under nitrous oxide and oxygen fully relaxed yet capable of rapid return to consciousness and early ambulation Many anaesthetists give a preliminary test dose of 3–5 milligrams of *d*-tubocurarine before the main dose, and a normal patient would still be able to open the eyes after this amount It must be remembered that if ether is being used (which itself has a neuromuscular blocking action) less *d* tubocurarine will be required No hard and fast rule of dosage can be given, but most geriatric patients will be completely relaxed after 15 milligrams of *d*-tubocurarine chloride It must be noted that some anaesthetists use the relaxants by continuous drip, in fact Evans and Gray (1953) have used a combination of thiopentone and gallamine triethiodide to maintain narcosis and relaxation, with excellent results Gray (1954) and his colleagues use succinylcholine chloride (Scoline) —1 in 1,000—for the same purpose However, repeated injections are remarkably satisfactory provided there is access to a suitable vein Lorhan (1955) recommends the use of 15 milligrams of *d*-tubocurarine mixed with 20 milligrams of a 2 5 per cent solution of thiopentone combined with nitrous oxide and oxygen at a flow of 2 and 2 5 litres respectively, and the author uses a mixture of 60 milligrams of gallamine mixed with 900 milligrams of thiopentone with similar inhalation cover Small intravenous injections of the mixture are given as required

METHODS OF ADMINISTERING ANAESTHETICS

Rectal methods

Paraldehyde is useful in ordinary healthy young adults by this route, but it is not recommended in old age unless the dose is very materially decreased to about half a drachm per stone body-weight This leads to uncertainty of action and it is not possible to guarantee that the patient will be asleep or that the fluid will not leak out past a poor sphincter ani

Bromethol (Avertin) is much more depressant to the respiratory centre than paraldehyde and is likely to last for too long post operatively The rectal route is not recommended for the geriatric patient as control of action is too uncertain

Intravenous route

The intravenous route is satisfactory if the short acting barbitrate thiopentone is used in small doses and with circumspection Allowance must be made for a possible slowed circulation time and the first injection should not exceed 150 milligrams before pause is made to note its effects Subsequent increments should be of the order of 100 milligrams and a maximum dose of 400 500 milligrams should never be exceeded Th

Nerve blocks

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sy as also upon the ease of approach for a particular nerve block Obviously there would be no point in performing a spinal or epidural block for an inguinal hernia with its attendant risk of fall of systolic blood pressure In this case a three point nerve block of the ilio-inguinal ilio-hypogastric and genital branch of the genito femoral nerve would suffice

Sp al (subdural) block

ar

its use of spinal block

of heavy Nupercaine would be used 1 millilitre would suffice for the elderly It must be remembered that spinal puncture may be very difficult owing to ossification in the intersp

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meth

hand

anaesthetists who use the method very successfully but it must be remembered that the spinal technique for the aged is only for those who have had long experience with this method when things go wrong

Spinal

America more in the United States of

block 44 nd Dripps (1949)

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of systolic bl

yet the overall

mortality in all forms of anaesthesia was not more than 4 9 per cent Baird (1943) used spinal blocks in 9 39 per cent of his patients and gives an overall mortality per 100 anaesthetics as 11 7 per cent in a series of 461 patients As mentioned earlier, however, spinal block should be restricted to below the tenth dorsal segment in old people The blood pressure should be maintained at reasonable levels, whether it is maintained by intermittent injections of drugs such as methyl amphetamine (Methedrine) or by a noradrenaline drip (1 in 500 000) is at the discretion of the anaesthetist It must be realized that arteriosclerosis and hypertension are definite contra indications to subdural block except in those cases restricted to saddle block only, for in this instance there should be no fall of blood pressure It is also unwise to administer a spinal block where there is coronary disease, myocardial insufficiency, disease of the central nervous system or syphilis Its use is justified perhaps for the difficult surgical approach where an epidural or other form of nerve block would be impracticable, or in acute pulmonary disease Spinal block has certain disadvantages apart from its effect on the cardiovascular system, for the incidence of post spinal headache varies from 1 to 10 per cent, and may rarely persist for a long time It is not unknown for neurological sequelae to develop, such as sixth nerve palsy, and minor degrees of cauda equina syndrome There are also occasional tragedies of paraplegia and ascending myelitis

The writer has used spinal blocks regularly for thirty years and has been fortunate in that no major neurological tragic sequelae have occurred in his practice, but he has personal knowledge of four instances having occurred in recent years, and this tends to make him extremely careful in deciding to use the method Thus before using spinal block the anaesthetist should ask himself the question "Will the use of spinal block give certain advantages to both patient and surgeon which justify its use, and overwhelmingly outweigh any disadvantages and risks of the method?"

Epidural block

This differs from spinal block in that the analgesic fluid enters a tissue space and does not intermix with spinal fluid Consequently there is no "tailing off" in percentage of strength of the analgesic as in spinal block This means that the fall in blood pressure will not be so profound for an equal height of analgesia as would be the case in spinal block On the other hand it is not so easy to control the height of analgesia as with spinal block unless a nylon catheter be introduced into the epidural space through a Tuohy needle By this means it is possible to introduce repeated small quantities of analgesic practically at the level of the nerve roots required, but although this practice has much to recommend it there is always the risk of sepsis and fracture of the catheter has been known to occur Advancing age leads to fibrosis and occlusion of the intervertebral foramina so that a lesser quantity of actual analgesic drug is required

Paravertebral block

Paravertebral block is extremely useful, and the technique is not difficult, but care must be exercised lest an unintentional subdural tap is performed by piercing a prolongation of the dura along an emerging nerve with consequent injection of

analgesic fluid into the spinal canal Paravertebral block has been recommended as a method of assessing whether a patient is likely to benefit from a lumbar sympathectomy

Intercostal block

Intercostal block at the angle of the rib (James) can be performed for abdominal section as also can a block in the mid axillary line This block is easily performed but there are certain drawbacks There is always some risk of puncturing the pleura and even damaging the lung Empyema has occurred as a complication and even cerebral abscess has been noted but the method should not be condemned too hastily If the block be performed at the angle of the rib, there will be some impairment of respiratory function, so that it is important that careful watch be kept to avoid anoxia Another drawback to intercostal block is that it necessitates multiple skin punctures

Abdominal field block or subcostal block

Abdominal field block or subcostal block as recommended by Dodd (1954) does not necessitate the same amount of skin punctures as does the intercostal block, and the method has the advantage of being simple, safe and quick Complete relaxation of the whole abdominal wall is obtained without any respiratory embarrassment and the risks attendant upon the actual needle insertions are minimal It must be remembered however, that with the subcostal and intercostal blocks the afferent imp [illegible]
sul
lef
fal [illegible] ssure unless pressor drugs are used to maintain peripheral vaso constriction

Brachial plexus block

[illegible]
M [illegible]
[illegible]

identified [illegible] patients where landmarks are *not easily*

Inguinal block

Inguinal block *of the ilio-hypogastric, ilio* inguinal and genital branch of the genital femoral nerve is easily performed (Macintosh and Bryce Smith, 1953, Labat, 1928)

Inferior haemorrhoidal nerve block

Infer [illegible]

Evaluation of methods

It is a comparatively easy matter to choose the right technique provided the anaesthetist bears in mind the fact that old people do not need heavy premedication, and that the method chosen allows the patient to come round quickly and post-operative sedation to be used with caution Time *does* matter when operations are performed on the elderly Consequently it is essential to select a method which will help and not hinder the surgical approach On the other hand it is not always wise to facilitate the surgical approach at the expense of cardiovascular depression Urinary output ceases below a systolic blood pressure of 60 millimetres of mercury and serious damage to the renal tubules can occur if this be allowed to persist

Deep surgical anaesthesia with ether or chloroform cannot be considered suitable for old age, for this encourages early shock. Therefore we really have to consider the advantages and disadvantages of very light anaesthesia combined with a relaxant where required, and some form of nerve block combined with sleep induced by thiopentone and maintained with nitrous oxide and oxygen or other combination of drugs Since abandoning spinal analgesia for perineo-abdominal excisions of the rectum in favour of nitrous oxide and oxygen with relaxant technique our mortality over 168 consecutive cases has been nil This compares very favourably with 6 deaths over 107 cases with the spinal technique If however there had not been adequate blood available for replacement the relaxant technique might have shown very different results The writer is reminded of two patients who underwent a perineo-abdominal excision of the rectum by the relaxant technique, one old gentleman of 83 years and a lady who admitted to 80 years, both of them made an uninterrupted recovery and walked out of hospital These are not isolated cases, but they were given adequate blood replacement on the table during the operation and antibiotic cover afterwards These patients admittedly had the benefit of blood, *antibiotics, and highly skilled surgery which meant that the duration of operation* was under an hour and a half Cyclopropane tends to increase haemorrhage and is perhaps unwise where there is serious cardiac disease, its great attraction is that there is a high oxygen content and a quiet respiration Nerve block is advantageous in that respiration need not be impaired However, when all is considered, the more experienced the anaesthetist the greater is the chance of the patient's survival

SUGGESTED TECHNIQUES FOR PARTICULAR OPERATIONS

Intestinal obstruction

The usual precautions of induction on a tilting table with sucker at hand must be observed If the patient has been obstructed for days rather than hours, the dehydration and collapse must be dealt with by intravenous glucose and saline Premedication should consist of atropine, 1/100 grain This should be followed by the passage of a Ryle's tube (usually considered too narrow a lumen) into the stomach Anterior intercostal block at the mid-axillary line will prove very effective and will not interfere with intercostal movement 1 per cent or 1 5 per cent lignocaine (Xylocaine) or 1 in 1,000 amethocaine hydrochloride, 3–5, millilitres, in the lower six intercostal spaces, will give adequate analgesia and relaxation, particularly if hyaluronidase (1,000 Benger units) has been added to the solution to aid spread

The writer does not recommend spinal or even epidural block as there will almost certainly be a lowered blood pressure Subcostal block is not an easy technique where the abdomen is distended However, the relaxant technique can be used but certain precautions must be observed Rapid intubation will be necessary, and consequently after having sucked the Ryle's tube dry the table should be tilted slightly with the head up Intubation with a cuffed tube follows induction with 200–250 milligrams of thiopentone immediately followed by succinylcholine chloride (Scoline) 50 milligrams, or gallamine triethiodide (Flaxedil), 60 milligrams, intravenously Maintenance may be with cyclopropane-oxygen and further doses of gallamine, or with nitrous oxide and oxygen with trichloroethylene or even minimal ether

Fractured neck of femur; Smith-Petersen pin

In this operation the necessary preliminary traction can cause shock and for this reason, some anaesthetists recommend the use of a subdural or epidural block to prevent this The writer, however, prefers to avoid this form of analgesia and use the more simple technique of modified premedication with slow induction with thiopentone to a maximum dose of 300 or possibly 400 milligrams followed by nitrous-oxide and oxygen maintenance to which trichloroethylene vapour is added until the preliminary manipulation and skin incision has been made The trichloroethylene is then shut off and the anaesthesia is continued with nitrous oxide and oxygen till the end of the operation Some patients benefit with small increments of 10 milligrams of pethidine at intervals, intravenously Pethidine is not such a respiratory depressant as morphine or papaveretum, but it must be used with circumspection, for the full effect is not seen for some two or three minutes and may be even longer if the patient has a slowed circulation time However, the writer has found that elderly patients stand this operation remarkably well with this technique and the octogenarians particularly so

TABLE XXIII

MORTALITY FROM PROSTATECTOMY

(50 cases (75–85 years) 10 per cent mortality)

Age	*No*	*Mortality*
75	22	1
76	11	1
77	5	Nil
78	5	2
79	—	—
80	3	1
81	—	—
82	1	Nil
83	1	Nil
84	—	—
85	2	Nil
	50	5

Note Of 7 patients in the above group over 80 6 made good recoveries.

The writer has used the technique of very light narcosis, coupled with epidural block consisting of 20 millilitres of a mixture consisting of equal parts of 2 per cent Xylocaine and 1 in 600 Nupercaine. This usually works well, but for those who prefer the spinal block to epidural block, 1 millilitre of heavy Nupercaine at the third lumbar interspace, with the patient sitting up will be found adequate, or, if a shorter duration of analgesia is desired, 1 millilitre of 5 per cent Xylocaine in 5 per cent glucose will prove excellent Cyclopropane tends to cause undue haemorrhage and the patient may need a blood transfusion in the post-operative period if this be used

Prostatectomy

Patients for this operation are usually poor risk cases, they are often emphysematous, may have some degree of cardiac failure, and may have an infected urine and damaged kidney Even so, the judicious use of a nerve block, be it subdural or epidural (provided it be limited in height to T10 or 12) with light covering "sleep" narcosis, can show a very good record (Jacobs, 1949) In 50 cases between 75 and 85 years of age there was a 10 per cent mortality, but of 7 patients over 80, 6 made a good recovery The oldest patient was 92 and he had a transurethral resection performed, the next in age was 90 and he had a transvesical prostatectomy The first one is alive and well three years afterwards and the latter is alive and well just one year afterwards

TABLE XXIV

CAUSE OF DEATH AFTER PROSTATECTOMY

Case No	*Age*	*When occurred*	*Remarks*
1	76	4th day	Fibrillation and myocardial failure
2	75	11th day	Persistent post operative hypotension and recurrence of former mental disturbance
3	78	10th day	Pontine haemorrhage
4	78	9th day	Sudden coronary attack
5	80	5 hours	Post operative shock

Cardiovascular and cerebral disturbances were the main causes of death

The anaesthetist, Dr Alex Forrester, has however, changed his technique from spinal to general anaesthesia and finds the mortality figures unchanged This suggests again the triumph of the man over the method The writer has experience of elderly patients for prostatectomy in the genito-urinary service of the Royal Masonic Hospital and has developed a technique of limited epidural analgesia In this instance equal parts of 2 per cent lignocaine (Xylocaine) and 1 in 600 Nupercaine are used as an epidural block 20–25 millilitres of the mixture are used and injection is made in the third lumbar interspace This limits the height of block to the 10th dorsal segment Sleep is maintained with nitrous oxide-oxygen after thiopentone induction The retro-pubic operation is performed which has the advantage of being quick and haemostasis is easily maintained Admittedly, the old Freyer operation is quicker, but haemorrhage is greater and not so easily controlled

The operation of transurethral prostatectomy with the diathermic cautery is performed with nitrous oxide oxygen following induction with thiopentone, and the patients are in excellent condition at the end Sometimes, however, haemorrhage can be quite considerable, in which case blood transfusion may be given with advantage

Haemorrhoids

Operations for haemorrhoids may be performed under a combination of inferior haemorrhoidal nerve block with minimal thiopentone to maintain unconsciousness (Evans, 1954)

Prolapse of rectum

A thiersch operation for prolapse is easily performed under minimal thiopentone

Amputation of the lower limb

The elderly patient with arteriosclerosis, especially if suffering from diabetes with gangrene of the lower extremities, should have the diabetes controlled sufficiently to rid the urine of acetone bodies If the patient be *in extremis*, the limb may be amputated by surrounding it with crushed ice for some two hours pre-operatively This is a messy procedure but is quite feasible and the limb can be reduced in temperature sufficiently, even without the use of a tourniquet which may be inadvisable in view of the arteriosclerosis It is, however, possible to produce quite a good local analgesia by injecting subcutaneously in a ring around the site of incision and making deep injections radially at right angles to the [illegible]

fo

POST OPERATIVE CARE

Ambulation

Early movement of the legs with active exercises is most [illegible]

suggests that sudden termi
previous exercise may incre

Intravenous infusions

Apart from actual blood replacement intraveno[illegible]
care for
ced
car
[illegible] for this purpose Elman (1952)

The writer has used the technique of very light narcosis, coupled with epidural block consisting of 20 millilitres of a mixture consisting of equal parts of 2 per cent Xylocaine and 1 in 600 Nupercaine This usually works well, but for those who prefer the spinal block to epidural block, 1 millilitre of heavy Nupercaine at the third lumbar interspace, with the patient sitting up will be found adequate, or, if a shorter duration of analgesia is desired, 1 millilitre of 5 per cent Xylocaine in 5 per cent glucose will prove excellent Cyclopropane tends to cause undue haemorrhage and the patient may need a blood transfusion in the post-operative period if this be used.

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gastrectomy, he was given a further injection of cortisone, 100 milligrams and in spite of a vomit on the table necessitating tracheal toilet, he made a rapid and uninterrupted recovery

MENTAL CHANGES

We tend to live longer nowadays and consequently surgeons find more people coming under their care who have passed the three score years and ten, and some who have passed the four-score mark Although old chronologically they may be younger physiologically than some of their sixty-year old companions All too frequently, however, they have experienced the "buffets of outrageous [illegible]

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holds that if the venous pressure remains below 100 millimetres of water there is little danger of overloading the circulation

Pulmonary complications

Pulmonary complications are minimized by careful pre-operative physiotherapy, and if infection be present steps should be taken to discover to what antibiotic the organisms are sensitive so that cover may be provided and continued during the post-operative period Deep breathing coupled with percussion assistance by the physiotherapist who helps the patient to cough can be most helpful Carbon dioxide inhalation is useful to make deep respiration possible where pain and apprehension are acting as inhibitors There is some evidence that detergent aerosols such as Alevaire may help in loosening bronchial mucus by reducing surface tension, but they should not be used if the patient is unable to cough Intravenous nikethamide (3 millilitres) may be given to encourage coughing to dislodge a mucus plug Bronchoscopy for this purpose should be as a last resort as it is apt to prove a most distressing experience for the patient

Pain relief

Morphine is not advisable as a routine, and should be restricted to one injection of ⅛ to ⅙ grain maximum Any further requirements should be met with injection of pethidine (Demerol), 50 to 75 milligrams This is not so depressant to the respiratory centre as morphine, does not cause sleep, and is a bronchodilator tending to dry up secretion Oral tab codein co (Veganin, Codis) is frequently all that the patient requires after the first few hours

Cardiovascular system

Coronary occlusion may occur quite suddenly after operation and may prove fatal Circulatory collapse needs energetic treatment with inhalation of oxygen, blood replacement direct into the arterial system if need be for haemorrhage, coupled with respiratory stimulants such as nikethamide to aid venous return *Adrenaline or noradrenaline may be given as an intravenous drip to obtain* peripheral vascular constriction, but there must be adequate circulating fluid otherwise the procedure is like flogging the tired horse (Evans, 1944)

Cardiovascular collapse can occur in the early post-operative period in those patients who have been receiving cortisone or ACTH and is due to depressed adrenal cortical function Slocumb and Lundy (1952) recommend the use of 100 to 200 milligrams of cortisone intramuscularly daily for two or three days before surgery and continued for the same period post-operatively Indeed the use of cortisone acetate, 100 milligrams, intramuscularly has proved of dramatic help in the treatment of shock

One case was that of a 73 year old male with a bleeding duodenal ulcer who showed no improvement after three pints of blood At this stage he was cold clammy and disorientated The blood pressure (systolic) was 80 millimetre of mercury and his pulse was 136 per minute Cortisone acetate, 100 milligrams intramuscularly was given, and two hours later he was mentally normal with a warm dry and pink skin After

Drugs

The action of drugs in elderly people may sometimes differ from that which is found in younger age groups (Salter, 1952) In many cases this is not due to an ... metabolism and excretion Chronic

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factor if any alimentary abnormality is present

Atherosclerotic arterial disease of some degree is inevitably present in the elderly

whenever the parenchyma of an organ has been extensively deranged by reduction of its blood supply the response to drug therapy tends to be disappointing

Narcotic and depressant drugs

Particular care must be taken in the use of narcotic and depressant drugs in those over 60 years of age Such patients are readily disturbed by doses of these agents which in younger people would have only a mild sedative effect Special

late in the body must always be remembered Untoward reactions are also seen sometimes when cerebral stimulants, such as atropine, are administered It is clear that drugs acting on the nervous system should be avoided whenever possible in elderly people and when essential they should be used with caution and in lower doses than in healthy young adults Indeed, this applies to the use of almost all drugs, because the range of adaptation of old patients is limited and they are particularly intolerant of any excess dosage

Effect of recent advances

Recent advances in treatment have usually benefited all age groups and it is difficult to select those which are of special importance in geriatrics There can, however, be little doubt that the introduction of chemotherapeutic and antibiotic drugs has greatly increased the chance of survival in old age Recovery from pneumonia is followed by a slow death from progressive degeneration of the cardiovascular system But even here new advances in the study of the pathogenesis and preventive treatment of atheroma of the coronary arteries and its complications are being made Indeed, there are few systems in the body not affected by the introduction of some fresh method of treatment However, new drugs with powerful

1 one must be fully

ged the expectation

their toxic actions

It is quite impossible to survey briefly the whole subject of treatment in old age,

CHAPTER 12

THERAPEUTICS IN THE ELDERLY

G M Wilson

GENERAL PRINCIPLES

The principles of the treatment of disease are in most respects not modified by the age of the patient Accurate diagnosis and good clinical judgement are always essential prerequisites Nevertheless, the care of elderly patients often calls for greater skill and attention on the part of the doctor than the management of similar diseases in the healthy young adult In the latter there is a strong natural tendency towards recovery, the bodily processes have an immense power of adaptation to changing circumstances, and the presence of multiple diseases is unusual On the other hand, in the elderly there is a progressive loss of rapid response to abnormal conditions, degenerative diseases affecting several organs frequently coexist and the main hope of therapy is often to ameliorate a chronic disability rather than to effect a permanent cure It is important for the physician to appreciate these limitations of therapeutics Much needless distress can be caused to elderly patients by drastic and injudicious investigation and treatment The essential aim should be to restore and maintain the functional capacity of the patient as a whole rather than to concentrate on pathological lesions which are frequently irreversible

In hospital

Visits

In the general management of elderly patients there are certain points that require special emphasis Old people in general dread visiting and entering hospital A visit, even to an out-patient department, however courteous and efficient the staff may be, represents a considerable upheaval in their daily routine Waiting for ambulances and trailing round special departments for radiological and laboratory investigations are especially tiring and may leave them completely exhausted Therefore, the necessity for a hospital visit should always be carefully considered and justified in each case

Admission to hospital

Admission to hospital likewise often has a deleterious effect The elderly patient does not adapt himself readily to the strange surroundings Mental confusion and restlessness may occur during the first few days in the ward and these may lead to a deterioration rather than to an improvement in general health, whatever the effect of treatment may be on a local disease process

Drugs

The action of drugs in elderly people may sometimes differ from that which is found in younger age groups (Salter, 1952) In many cases this is not due to an altered tissue response but to differences in metabolism and excretion Chronic renal disease, so common in the old, may diminish the rate of excretion and lead to accumulation in the body and excessively high blood concentrations On the [illegible]

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vascular system But [illegible]
preventive treatment [illegible]
are being made Inde[illegible]
introduction of some [illegible] However, new drugs with powerful pharmacological actions always bring new dangers of which one must be fully cognisant Although these remedies have in general prolonged the expectation of life in individual cases they may drastically shorten it by their toxic actions

It is quite impossible to survey briefly the whole subject of treatment in old age, [illegible]

but with these points in view certain topics have been selected to illustrate some recent trends in geriatric therapeutics

CONTROL OF INFECTION BY SULPHONAMIDES AND ANTIBIOTICS

The general principles of the use of antibacterial substances remain the same in the elderly as in any other age group The common invading organisms are similar at all ages and the action of the chemotherapeutic agents against the parasites is not modified by the age of the host The changes in the tissues in the ageing process may to a certain extent modify the ability to resist infections The atrophy of the lymphoid tissue, spleen and reticulo-endothelial system may diminish the capacity for antibody production Many of the endocrine glands are intimately concerned with the metabolic response to infection and injury, and in old age there is evidence that this reaction is less vigorous than in younger age groups (Moore and Ball, 1952) An impaired state of nutrition likewise diminishes the resistance to infection If these factors are in addition associated with chronic disease the response is still further impaired Indeed, this relative lack of reaction is one of the characteristics of infections or surgical operations in the elderly The constitutional effects of even an extensive pneumonia may scarcely be observed, leading to difficulties in recognition of the condition and in assessing the result of treatment

An appreciation of the toxic and undesirable effects of sulphonamides and antibiotics is of particular importance Their appearance may greatly increase the gravity of any infectious illness and may constitute a real danger to life These complications have been described recently in considerable detail (Hussar and Holley, 1954, von Oettingen, 1955), and are of special significance in geriatric therapeutics

Allergic and sensitization reactions

There can be few in the Western World who attain adult life without having received penicillin in some form The use of antibiotics has expanded at an enormous rate and this is naturally associated with an increased incidence of sensitization reactions Furthermore, particularly in the case of penicillin, not only is the use more widespread, but the dosage is also being greatly increased The enhanced tissue concentrations produced in this way may further increase the liability to undesirable reactions (Lehr, 1955)

Cutaneous eruptions

Cutaneous eruptions may develop with all types of chemotherapeutic substances They are fairly common after sulphonamides, penicillin and streptomycin but are rarely seen after the tetracyclines and chloramphenicol They are usually mild and subside rapidly on discontinuing the medication Rarely, they may be severe and even progress to an exfoliative dermatitis Before any of these agents is given it is always a wise precaution to enquire about any previous administration and associated skin rashes or untoward effects Serious anaphylactoid reactions are occurring more commonly, particularly following penicillin and it is probable that nearly one third are fatal (Hussar and Holley, 1954, von Oettingen, 1955, Calvert and Smith, 1955)

Drug fever

Drug fever is frequently seen in the elderly. Though in itself probably not of great importance, it is always a warning to look for other more serious complications such as granulocytopenia. It may lead to unnecessarily prolonged courses of treatment and increased dosage in the mistaken belief that the infection has not been brought under control. Numerous and large injections are ill tolerated in the elderly and poorly nourished and of course increase the liability to further complications.

Injury to bone marrow caused by chloramphenicol

Chloramphenicol is the only antibiotic which may at all commonly cause injury to the bone marrow. Numerous cases of aplastic anaemia have now been recorded following its use (Lewis and his colleagues, 1952). There is some evidence that the aplasia results from sensitization of the patient, as a short initial course is usually well tolerated and trouble only occurs when a second course is given. Occasionally aplasia may be caused by an existing hypersensitivity and only a few doses of a first course precipitate the condition (von Oettingen, 1955). However, this is uncommon and it is clear that the greatest danger arises from prolonged administration and repeated courses. A high proportion of cases of aplastic anaemia caused in this way are fatal. This antibiotic should accordingly be reserved for the treatment of typhoid fever, where it is undoubtedly the most effective agent, and should not be used in other conditions, particularly when other agents are available. In elderly people chronic and recurrent infections are common and in them the *greatest danger* arises as the nature of previous medication may not be readily ascertained and another "first course" may be prescribed by oversight.

Alimentary disturbances

Nausea, vomiting and diarrhoea are not uncommon after the ... of certain antibiotics, especially ... or debilitated patient these may ... diarrhoea ... of ... ox ... sev ... they are used in the form ... may also occur with the others, particularly if ... of these ... the precise mechanism ... bacterial ... with changes in the ... defective absorption of vitamins. The effect of antibiotics on intestinal bacteria is of considerable importance since undesirable effects are readily produced by prolonged suppression of the growth of certain types of bacteria resident in the intestines. An invasion by antibiotic resistant strains, particularly staphylococci, may produce severe reactions (Brodie, Jameson, and Somm... ... invading organisms may not be ... to any available antibiotic (Weinstein, Goldfield and Chang, 1954, Fowler, 1955). Over-growth of yeast and mould like organisms may follow

prolonged administration of any antibiotic Infections with *Candida albicans* are particularly common in such circumstances and may cause much distress or even death (Brown and his colleagues, 1953, Caplan, 1955)

In general, it is clear that suppression of the normal bacterial inhabitants of the intestinal tract may be followed by secondary infections which are occasionally of greater severity than the original disease The development of complications of this type can be serious in the elderly and this possibility should be remembered whenever long courses of the broad spectrum antibiotics are given

Renal lesions

Renal lesions are not commonly seen after antibiotic therapy They develop mostly in those with some pre-existing impairment of kidney function and are seen usually after the use of the more recently introduced antibiotics such as bacitracin, neomycin and polymyxin B The danger from sulphonamides as a result of crystal formation in the renal tubules is well recognized The elderly are often unwilling to consume large quantities of fluid and there may be difficulty in administering adequate amounts of alkalinizing salts of sodium and potassium to those with cardiovascular and renal disease The introduction of triple mixtures of sulphonamides has, however, reduced the danger (Lehr, 1947, 1950, 1953) though it is doubtful whether they now have much advantage over the more recently introduced compounds such as sulphadimidine Sulphonamides can be used with safety even in advanced age but naturally in the presence of obviously reduced renal excretory capacity the dose must be modified and a careful check maintained on the blood concentration

General principles

Certain general principles emerge from consideration of the complications that may arise as a result of antibiotic therapy In the first place antibiotics should not be used unnecessarily in the treatment of minor infections and of conditions in which no response may reasonably be anticipated Secondly, in using the broad spectrum antibiotics the minimum effective therapeutic dose should be used so that irritation of the intestinal mucosa and the likelihood of over-growth of resistant organisms may be avoided as far as possible Thirdly, elderly patients must be closely observed for the emergence of toxic reactions as their ability to withstand them is in general less than that of young adults In particular, if definite diarrhoea develops on or after the third day of antibiotic treatment, further oral treatment should not be given This is of especial importance if there is an invasion of resistant staphylococci Other antibiotics, such as erythromycin, may be used but strains resistant to all the newer antibiotics are already appearing (Bryer, 1955)

Respiratory and urinary infections are commonly encountered in the elderly They are often chronic in nature and the bacterial flora mixed and difficult to eradicate They accordingly call for special consideration.

CHEMOTHERAPY OF URINARY TRACT INFECTIONS

The response to treatment of urinary infections is on the whole disappointing While an acute attack by a specific organism in the young adult with no anatomical abnormality can frequently be quickly and permanently cured, the position is

very different in the aged (O Conor and Rhoads, 1953) In them there are commonly associated abnormalities and obstructing lesions in the urinary tract and the infection is deep-seated and chronic The correction of anatomical abnormalities must be undertaken whenever possible A search must also be made for conditions reducing the general resistance of the patient, such as diabetes mellitus and pernicious anaemia The causative organism and its sensitivity to sulphonamides and antibiotics must be determined by culture of the urine Isolation of the species is no longer sufficient as the resistance of an organism varies greatly There is fortunately usually a close relationship between the *in vitro* sensitivity and the result of treatment, therefore the prescription of inappropriate, expensive and potentially dangerous substances may be avoided *Eberthella coli* and *Staphylococcus aureus* are the commonest urinary pathogens but in complicated infections, strains of *Proteus*, *Pseudomonas* and *Enterococcus* are frequently encountered, often in combination These complicated, chronic and mixed infections are difficult to control and re-infection and relapse rates are high (Garrod, Shooter, and Curwen, 1954, Kass, 1955) It is important to draw attention to the high rate of infection seen after [illegible]

[illegible]

In acute infections sulphonamides are effective against most of the common causative organisms In mild infections relatively small doses (0 5 gramme six-hourly) of any of the commonly used sulphonamides are sufficient In severe infections, especially those with renal involvement, full doses are indicated Mixtures of sulphonamides, as already described, have advantages with regard to solubility in the urine when these higher blood and tissue concentrations are desired Penicillin may be used against certain gram-positive organisms, and also against proteus infections in which there is a high proportion of the *Proteus mirabilis* strain (Potee Wright, and Finland, 1954) Streptomycin is most active in an alkaline urine and sodium bicarbonate or citrate should be *given to* keep the pH as near 8 0 as possible The emergence of resistant organisms is common rapid and usually complete with this antibiotic and its use should not normally exceed four or five days The broad spectrum antibiotics should, in general be reserved for infections not *responding* to other measures In acute infections and exacerbations, a period of rest in bed may be essential *but this* should be as brief as possible *in* view of the danger of the development of venous thromboses in the lower limbs *Dehydration* is often present during the acute stage and must be corrected by giving adequate fluids, preferably by *mouth* if at all possible

It must be admitted that the treatment of chronic urinary tract infections in the elderly is still unsatisfactory in *many* cases *It* is relatively easy to procure temporary amelioration and negative cultures at the end of a course of treatment Permanent eradication of the *infection* is uncommon and *in* a high proportion of cases re infection or relapse occurs The rational use of chemotherapy and antibiotics can afford much help to these patients, particularly in the control of acute infections and exacerbations, but more fundamental knowledge is clearly required before therapy can be established on a more reliable basis

MANAGEMENT OF URINARY INCONTINENCE

Causation

Inability to control the passage of urine is common and is a matter of great importance as it is one of the chief factors in limiting the possibility of care of the elderly at home Local abnormalities in the urinary tract and infections should be treated but they are not usually the principal causes of the development of incontinence, though they may aggravate the condition Over activity of the neuromuscular mechanism rather than weakness of the vesical sphincter is the main cause of incontinence (Wilson, 1948) Commonly the general state of the patient is of more importance than the urinary system in its treatment Impaired cortical control of the bladder reflexes may be due to disease of the nervous system, frequently atherosclerotic in origin An impairment of mental state due to any cause may have a similar effect Failure to inhibit bladder reflexes may be transient as in the period immediately after a cerebrovascular accident or during a febrile illness, and subsequently partial or complete recovery may ensue Emotional disturbances are often important Incontinence frequently develops after a change of surroundings or an introduction to unfamiliar circumstances Many of these factors may work in conjunction

Treatment

Encouragement of self confidence

In the treatment of incontinence any underlying factors both general and local, must be corrected as far as possible It is of considerable importance to get the patient out of bed during the day time This helps to restore his self confidence which is the basis of successful treatment If he can be made to walk unaided so that he can attend to his personal needs this may effect a cure in many cases Encouragement is of great importance He should be praised for his successes rather than chided for his failures He should be taught to empty his bladder regularly throughout the day and to restrict fluid intake during the afternoon and evening if there is incontinence at night If the patient is necessarily confined to bed a urinal or bed pan must be readily available

Drugs

Drugs afford little assistance but sympathomimetic agents, such as ephedrine, are often recommended Their prescription can in no way take the place of detailed supervision and personal encouragement Cystometry is useful in many cases and function often improves as a result of gradual distension of the bladder with fluid and redevelopment of the inhibitory reflexes (Wilson, 1948)

Incurable incontinence

Men—However, there remain a large number of patients who are incurable, but much may be done to alleviate their discomfort and assist them to lead normal lives Various appliances of the rubber bag type can be worn comfortably by ambulant men although it is inadvisable to initiate their use in any patients for whom there is a hope of cure The wearer finds it easier to continue using the bag than to make the effort required to regain control of his bladder Men who are

bed ridden may keep a glass urinal permanently in position This is easily cleaned and disinfected and the chill of the glass can be avoided by covering the article with an old sock

Women —The problem of persistent incontinence in women is far more difficult to solve The constant smell of urine is most distressing to the patient and her knowledge of its offensiveness frequently makes her a social outcast The skin of the perineum and the inner sides of the thighs usually becomes excoriated, which makes walking painful This can be alleviated, and to some extent prevented, by the liberal use of a soft ointment on the parts exposed to the urine Most appliances for female incontinence are unsatisfactory, but a fairly comfortable and relatively cheap method may be found by the use of cellulose wadding An outer covering of old sheet or similar material, which may be washed and used again is made on the envelope principle, and inside this is placed a triple layer of cellulose wadding The pad is worn fastened on to a sanitary belt A strip of plastic or rubber sheet about 10 centimetres in width is worn over the outer surface of the pad which can then be changed as frequently as necessary A thicker layer of wadding is required at night The same effect can be achieved at greater expense by the use of maternity sanitary towels with a similar plastic outer covering

RESPIRATORY INFECTIONS

The specific treatment of acute respiratory infections such as pneumococcal pneumonia is no different from that in other age groups and calls for no special comment The general management of an old patient with this type of infection demands special care, the principles of which have already been described

Chronic bronchitis and bronchiectasis

Chronic bronchitis and bronchiectasis are common disorders in later life and cause much suffering and ill health, as has been described in Chapter 7 The use of antibiotics in their treatment is of considerable interest Once chron[illegible] has become [illegible]
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and ve[illegible]
use of [illegible]
Clinic[illegible]
respor[illegible]
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Choice of prophylactic agent

The choice of prophylactic agent raises many difficulties, particularly with regard to the hazard of invasion by drug resistant organisms and the development of toxic reactions Living in an open community, the chances of developing resistant strains are reduced Combinations of penicillin with sulphonamide triple mixtures

have been advocated by Lehr (1955) for this type of prophylaxis The chief advantages of this combination are stated to be that upper respiratory infections are generally due to a mixed flora, including *Streptococcus haemolyticus*, *Streptococcus viridans*, *Staphylococcus aureus*, *Neisseria*, diphtheroids and pneumococcus, all of which are sensitive to sulphonamides and penicillin These two substances may be synergistic in action (Daly, 1954) On the other hand, McVay and Sprunt (1953) preferred a broad spectrum antibiotic and used 0·25 gramme of chlortetracycline twice a day Helm and his associates (1954) chose oxytetracycline It is possible that the newer preparation, tetracycline, which is stated to be equally effective, but less toxic, may turn out to be more suitable for prolonged therapy (Finland and his colleagues, 1954) It is clear that the prophylactic use of these agents does offer some opportunity of lessening the disability caused by chronic bronchitis and bronchiectasis. Before the value of this type of prophylaxis can be fully assessed, more carefully controlled therapeutic trials are required Without doubt more knowledge of the causation of the relapses is an essential preliminary to establishing the therapy of chronic respiratory diseases on a firmer and more certain basis

Pulmonary tuberculosis

Pulmonary tuberculosis is often overlooked, particularly in the elderly male, in whom it is a relatively common condition It is important to recognize and treat the condition in order to preserve the health of contacts Collapse therapy and surgical treatment are not usually advisable in this age group as the disease is generally associated with much fibrosis and emphysema Chemotherapy does not often lead to any spectacular change in radiological appearances but may rid the sputum of tubercle bacilli and lead to some clinical improvement Streptomycin should be administered in small doses such as 1 gramme thrice weekly because the elderly are more prone to develop vestibular disturbances than younger people This should be combined with either *para*-aminosalicylic acid, 10–20 grammes a day in divided doses, or *iso*-nicotinic acid hydrazide, 100 milligrams twice daily The latter is less likely to cause side effects in the elderly Treatment must be prolonged and the various combinations may be alternated in three-monthly courses Strict attention must be paid to personal hygiene and the disposal of sputum in order to avoid spreading the disease as so many of these old patients are now treated at home They should avoid coming into contact with children and B C G. vaccination should be carried out in the family where indicated

CARDIOVASCULAR DISEASES

The importance of atheromatous changes in the arteries as a cause of morbidity in the elderly requires no elaboration and much recent research has been directed to a study of the factors of age and sex in the development of this form of arterial disease (Peel, 1955) The association of a disturbance of lipid metabolism with coronary atherosclerosis and myocardial infarction has recently been established by several workers (Oliver and Boyd, 1953a, 1955, Gertler, Garn, and Bland, 1950, Steiner, Kendall, and Mathers, 1952 Page, 1954) It has also been shown that the incidence of coronary arterial disease is increased in those countries and races

[illegible] (Bruce, Stuart, Ross and Brock, 1952). In this connection it is not surprising that the use of substances to reduce the level of blood lipids has been explored in the prophylactic treatment of atheroma [illegible]. The effect of heparin in clearing the turbidity of plasma caused by [illegible] (Hahn, 1943). Furthermore, heparin [illegible] the [illegible] of human plasma [illegible] lipoprotein [illegible] (Graham and [illegible]). However, heparin has less effect in changing the [illegible] of [illegible] with atherosclerosis [illegible] (Rosenberg, Nichols and Moses, 1952; Oliver and Boyd, 1953). It has been claimed [illegible] heparin [illegible] lipoprotein pattern towards normal [illegible] but [illegible] and Moses [illegible] that the [illegible] of 100 mg. [illegible] of heparin twice weekly [illegible] had no demonstrable effect on serum lipoproteins.

[illegible] (Rickets and his colleagues, 1953) [illegible] heparin [illegible] so that less frequent injections are required [illegible]

[illegible]

[illegible] (Best and his colleagues, 1954; [illegible] and [illegible], 1954; [illegible] and [illegible], 1955). [illegible] a daily [illegible] and may be given [illegible] of 6 grammes three daily. No undesirable side effects have been reported. The use of such substances to delay the onset of atherosclerosis in the elderly [illegible] experimental and it is not yet possible to form [illegible] place in therapeutics.

Much work remains to be done in determining the effect of altering the serum lipoprotein pattern on the further course of atheroma [illegible] who has already had a coronary thrombosis. The [illegible] of [illegible] [illegible] but in [illegible] of the nature it is [illegible] that [illegible] lipoprotein [illegible] Further [illegible] [illegible] [illegible] So far little attention has been paid to the behaviour of serum lipoproteins in [illegible] atheromatous [illegible] the cerebral and peripheral arteries [illegible] in the elderly patient.

Angina pectoris

In [illegible] elderly patients [illegible] due to atheromatous arterial disease [illegible] in which the [illegible] is aggravated by [illegible] the underlying disease [illegible] Relief [illegible] avoiding [illegible] (Wilkinson and [illegible], 1951). [illegible] of weight in the obese is a [illegible] measure. The [illegible] of [illegible] glyceryl trinitrate (0.5–1.0 mg.) [illegible] under the tongue may help [illegible] prophylactic [illegible] prior to [illegible] and [illegible] exertion, such as climbing the stairs to bed or [illegible] Recently a new long-acting coronary vasodilator, pentaerythritol tetranitrate, has been introduced. This has an action lasting up to [illegible] hours after

have been advocated by Lehr (1955) for this type of prophylaxis The chief advantages of this combination are stated to be that upper respiratory infections are generally due to a mixed flora, including *Streptococcus haemolyticus*, *Streptococcus viridans*, *Staphylococcus aureus*, *Neisseria*, diphtheroids and pneumococcus, all of which are sensitive to sulphonamides and penicillin These two substances may be synergistic in action (Daly, 1954) On the other hand, McVay and Sprunt (1953) preferred a broad spectrum antibiotic and used 0·25 gramme of chlortetracycline twice a day. Helm and his associates (1954) chose oxytetracycline It is possible that the newer preparation, tetracycline, which is stated to be equally effective, but less toxic, may turn out to be more suitable for prolonged therapy (Finland and his colleagues, 1954) It is clear that the prophylactic use of these agents does offer some opportunity of lessening the disability caused by chronic bronchitis and bronchiectasis Before the value of this type of prophylaxis can be fully assessed, more carefully controlled therapeutic trials are required Without doubt more knowledge of the causation of the relapses is an essential preliminary to establishing the therapy of chronic respiratory diseases on a firmer and more certain basis

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from hospital Tudhope and Donald (1954) have produced evidence suggesting that in patients surviving one month after myocardial infarction, the mortality rate during the next eleven months was considerably lower in those who had received anticoagulants It is usually considered that treatment with anticoagulants should be continued for at least four weeks after the last thrombo-embolic episode, but recently more prolonged therapy has been attempted on an out patient basis (Nichol, Phillips and Jenkins, 1954, Keyes and his colleagues, 1953, Tulloch and Wright, 1954)

In spite of the large mass of evidence produced by Wright and his colleagues there are still many differences of opinion about the treatment of myocardial infarction Russek and Zohman (1954) consider "good risk" cases do not require anticoagulant therapy In these patients, comprising about 46 per cent of the total the mortality and incidence of thrombo-embolism is so low that anticoagulant therapy with its attendant risk of haemorrhage does not materially improve the prognosis Furman and his associates (1953) also showed that "good risk" cases [illegible]

where the prognosis is thought favourable (Halpern and his colleagues, 1954).

The controlled studies on the value of anticoagulant therapy have all been carried out on patients admitted to hospital Wright particularly stresses that in giving an anticoagulant, facilities must be available for meticulous supervision of its administration This probably represents the crux of the problem for it is undoubtedly preferable to avoid the admission of elderly people to hospital as far as possible There is evidence that many milder cases can be treated satisfactorily withou[illegible] if they are not confined strictly [illegible] here are many differences of opin[illegible] that the aged tolerate haemorrhage bad[illegible]

[illegible] myocardial infarction The exertion and excitement associated with this emergency journey can do nothing but harm at this stage, and anticoagulant therapy cannot prevent deaths due to shock or ventricular fibrillation in the first few hours after [illegible] few hours, until the immediate [illegible] mfortable under the influence [illegible] If the diagnosis is reasonably certain, an intravenous injection of 10,000 units of heparin can be given by the family doctor so that the patient would not be denied the benefit of early anticoagulant therapy

Continuous treatment with heparin has the great disadvantage of requiring frequent intravenous injections Dextran sulphate has an anticoagulant action similar to that of heparin but it is cumulative After the first 24 to 48 h[illegible]

oral administration of 10–20 milligrams (Russek and his colleagues, 1955) Elderly patients should be encouraged to move about up to the limit of their tolerance short of producing pain There is no evidence that rest or inactivity improves the ultimate prognosis

Myocardial infarction

Recent trends include the realization that strict confinement to bed for an immutable period of weeks is not the ideal treatment of this condition in an elderly patient There is much to be said for encouraging the patient to get up as soon as the acute stage has passed and the "armchair" method should if possible be used in all patients over 70 years old (Levine and Lown, 1952) The use of a bedside commode is also essential and saves aged patients the distress of attempting to use a bed pan

Treatment by anticoagulant drugs

The use of anticoagulant drugs has reduced both the mortality and morbidity associated with myocardial infarction (Wright, Marple, and Beck, 1954, Gilchrist and Tulloch, 1954) The usual practice is to begin treatment with the concurrent administration of ethyl biscoumacetate or phenindione orally, and heparin six hourly by intravenous injection The heparin is discontinued after the first 36 to 48 hours, when the oral anticoagulant has become effective in prolonging the prothrombin time It is imperative that the dosage of ethyl biscoumacetate or phenindione is carefully controlled by prothrombin time estimations The necessary close liaison between clinician and laboratory is difficult to achieve other than in hospital The aim should be to keep the prothrombin time at between two and two and a half times the normal level If the patient has survived the immediate effects of a coronary thrombosis the greatest danger lies in thrombo embolic complications The liability to complications increases with advancing age Anticoagulant therapy greatly reduces this risk of thrombo embolism especially in the 50 to 69 age group (Kerwin, 1953, Wright, Marple and Beck, 1954) Wright and his associates recommend anticoagulants for all cases of myocardial infarction irrespective of age, sex and the severity of the patient s condition

Risk of haemorrhage.—The haemorrhagic complications occurring during treatment in hospital have been reported in detail Bleeding occurred in 12 9 per cent of the treated patients but it also was reported in 5 2 per cent of the control group The majority of the haemorrhagic incidents were mild, such as microscopic haematuria, and only four severe episodes were encountered in 577 treated patients On this basis, Wright and his associates consider that the benefits of anticoagulant treatment in myocardial infarction outweigh the risks of haemorrhage These figures refer to the use of dicoumarol but the incidence of haemorrhage is less with more recently introduced preparations such as phenindione

Prognosis and mortality rate.—The reduction in mortality achieved by the use of anticoagulants is due largely to the prevention of thrombo embolic complications The prognosis is not only considerably better for patients treated with anti coagulants while in hospital, but this improved outlook continues after discharge

the same considerations in the aged arise as in the treatment of coronary thrombosis. Prevention is thus of great importance and lies essentially in ensuring use of the lower limb musculature If oedema develops firm support with an elastic stocking is important Once chronic swelling supervenes and the tissues have become over-stretched cutaneous ulceration and infection readily occur.

Peripheral ischaemia

Peripheral ischaemia is usually due to thrombosis on atheromatous lesions in the major arteries of the limb Little can be done to reverse this process After a sudden occlusion the major danger is the development of peripheral gangrene. Care of the limb in these circumstances is of great importance. If there is any oedema present it is often tempting to elevate the foot but this should always be avoided as it is a potent method of reducing blood flow distal to the occlusion (Wilson, 1951) The limb should be carefully protected from injury, particularly thermal injury from hot water bottles It should be kept cool, about 21°C., but

[illegible]

the opportunity for arterial grafting in the elderly is exceptional because the disease

[illegible]

The development of antibiotics

[illegible] tissue and more conservative operations are now often possible, particularly when the condition is associated with diabetes mellitus.

Intermittent claudication

In patients with established intermittent claudication the same general principles apply with regard to the care of the limbs (Wayne, 1954) Particular attention must be paid to avoiding minor injuries [illegible]

[illegible]

[illegible] should never be applied to any part of the feet

Peripheral vasodilator drugs [illegible] to have any beneficial ef[illegible] mittent venous occlusion [illegible]

[illegible] are important accessory measures.

ALIMENTARY SYSTEM

Minor disturbances of the digestive tract [illegible]

[illegible] in the abdominal

over heparin and the reduction in frequency of intravenous injections is particularly welcome in the treatment of elderly patients. Dextran sulphate undoubtedly opens up the possibility in the future of anticoagulant treatment in the home without day-to-day laboratory control Careful attention will still be required and if the treatment cannot be adequately supervised patients are better off without it.

There can be no doubt that at the present time there is a place for domiciliary treatment of myocardial infarction without the use of anticoagulants In deciding on treatment in an elderly patient with a recent coronary thrombosis the physician must weigh up many factors The feasibility of nursing an old patient at home may well be a determining factor because the avoidance of sudden transfer to unfamiliar surroundings may counter-balance the possible advantages of anticoagulant therapy.

Congestive cardiac failure

In the elderly this is commonly secondary to hypertension, coronary atherosclerosis and chronic pulmonary disease. It is often difficult or impossible to assess the individual contribution of these different processes The importance of the prevention and immediate treatment of exacerbations of chronic pulmonary disease has already been stressed as these so commonly precipitate attacks of heart failure. The general principles of the management of congestive cardiac failure are similar at all ages and call for no special comment in the elderly Auricular fibrillation in the elderly commonly leads to slower ventricular rates than are found in younger adults with, for example, mitral stenosis Digitalis often does not produce such dramatic effects in auricular fibrillation in old age and relatively more reliance has to be placed on salt restriction and mercurial diuretics.

Thyrotoxicosis as a cause of cardiac failure

Thyrotoxicosis is an occasional cause of cardiac failure in the elderly and certainly aggravates the effects of degenerative heart disease It is important that it should not be overlooked, particularly as the clinical features may not be so florid as in the young, for it is a condition that responds readily to treatment Radio-iodine is particularly useful as a form of therapy in the elderly patient with cardiac failure as it avoids the hazards of anaesthesia and thyroidectomy It is described more fully in a later section.

Peripheral circulatory disease

Disorders of both the peripheral arteries and veins are common in the elderly and constitute a most difficult group of conditions from the point of view of relief of suffering.

Thrombophlebitis in the legs

Thrombophlebitis in the legs can be troublesome and is especially liable to develop in elderly people confined to bed Deep thrombosis is potentially dangerous as it may lead to pulmonary embolism It is difficult to treat because in the early stages anticoagulants are the only agents that affect the course of the disease and

the same considerations in the aged arise as in the treatment of coronary thrombosis Prevention is thus of great importance and lies essentially in ensuring use of the lower limb musculature If oedema develops firm support with an elastic stocking is important Once chronic swelling supervenes and the tissues have become over stretched cutaneous ulceration and infection readily occur.

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occlusion
ticularly
°C, but
excessive cold should be avoided The trunk and upper limbs should be heated to provoke vasodilatation in the lower extremities If there are any signs of infection antibiotic therapy, usually penicillin, should be given immediately In general, the opportunity for arterial grafting in the elderly is exceptional because the disease is usually widespread (Rob, 1953) If gangrene supervenes it may be possible to wait for a line of demarcation to appear and to allow the necrotic tissue to separate of its own accord. If
iding to a deterioration of the
The development of antibiotics
tissue and more conservative
ien the condition is associated

Intermittent claudication

In patients with established intermittent claudication the same general principles apply with regard to the care of the limbs (Wayne, 1954) Particular attention must be paid to avoiding minor injuries from new or ill fitting shoes or from treading on the toes The feet must be kept clean, cutting of the nails should be done with great care only after a bath when the tissue is soft, and strong antiseptics and destructive agents should never be used

ALIMENTARY SYSTEM

Minor disturbances of the digest...

... in the abdominal

muscles Difficulty of access to a toilet, particularly if it is situated outside in the cold, may defer the action of defaecation and in turn lead to insensitivity of the rectum and impaction of scybala In treatment the first essential is to exclude an obstruction such as a carcinoma The patient should then be reassured regarding the benign nature of constipation, and told that a daily bowel motion is not essential for the preservation of good health Advice about diet, fluid intake and exercise should be given Digital removal of impacted faeces, an enema or aperient may be required in the first instance, but an attempt should be made to do without artificial aids of this nature The most satisfactory laxatives for use in the elderly are preparations such as liquid paraffin emulsion and liquid paraffin and magnesium hydroxide emulsion Routine use of purgatives is unfortunately common but it is to be deprecated It should be remembered that the artificial production of frequent watery motions may lead to potassium depletion and may occasion disability (Schwartz and Relman, 1953)

Diarrhoea and dysentery

Diarrhoea from other causes is also common in old people It may be due to a wide variety of disorders and needless to say an accurate diagnosis is an essential preliminary to treatment, which should be directed at the underlying condition rather than the symptom Carcinoma, diverticulitis uraemia and diabetes mellitus must not be overlooked Infective diarrhoeas are not uncommon particularly in old people's homes When this is due to bacillary dysentery, treatment with the group of sulphonamides which are poorly absorbed is common practice The usual dose of for example, succinylsulphathiazole is 3–4 grammes six hourly for four to five days It is important to remember that a small quantity may be absorbed and that this on occasion may give rise to toxic effects Sulphonamides which are readily absorbed are equally or more efficacious in controlling bacillary dysentery because the organisms actually invade and multiply in the bowel wall Sulphadiazine is normally the agent of choice This affords an earlier clinical and bacteriological response than the poorly absorbed sulphonamides, which only act within the lumen of the intestine It is important to remember that Sonne organisms, in contrast to the Flexner group, are often resistant to sulphonamides Correction of the dehydration is always an important aspect of the treatment

Faecal incontinence

Faecal incontinence is particularly distressing both to the patient and those caring for him The general factors associated with its development are similar to those causing urinary incontinence The commonest local factor is faecal impaction, which leads to involuntary discharge of liquid faeces held up above the obstruction The removal of a hard, scybalous mass from the rectum may be achieved by instillation of warm olive oil and digital breaking up and extraction This may be followed by occasional enemas during the next fortnight to ensure complete emptying of the bowel Once the impaction has been relieved every effort must be made to restore normal bowel function This is most readily obtained if the patient can get up and visit the toilet on his own Persistent faecal incontinence in the bed ridden is most difficult to manage The patient may be placed on a cellulose wadding pad covered by a single layer of gauze, which prevents

add no when wet Nursing doubly incontinent women has mattress which This is mattress not available in most is at least firm, that the covering rubber sheet is of sufficient size and that scrupulous care of the back and frequent changing of the pad are carried out to prevent the formation of bed sores

Peptic ulcer

a common abnormal to achieve rding relief of symptoms apart from the development of such perforation, haemorrhage and pyloric stenosis Rigid dietetic restriction is inadvisable especially as there is no convincing evidence that it speeds healing, and it is certainly an occasional cause of scurvy in the elderly The danger of alkalosis and uraemia as a combined result of vomiting and the prescription of soluble alkalis such as sodium bicarbonate must be kept in mind as this complication is poorly tolerated in the elderly Magnesium trisilicate and aluminium hydroxide gel are suitable antacids Confinement to bed should be avoided as far as possible, though it may be essential during phases of exacerbation associated with persistent pain

Gastroduodenal haemorrhage

In a severe gastroduodenal haemorrhage, it is of the first importance that the blood lost is promptly and fully replaced by transfusion *Haemorrhage is an* in the aged whatever form of treatment is much stronger the prognosis (Jones, 1947)

Treatment —Treatment should probably be medical in the first instance, but older patients with continued or recurrent bleeding.

fixed The mental and physical health rather than the actual age should be the deciding factor

Perforating ulcer

Perforation of an ulcer is a definite indication for surgery but carries a high mortality in the elderly Often the classical features seen in younger patients are missing and the condition may not be diagnosed until relatively late Mild pyloric obstruction may be relieved by rest in bed, gastric lavage and replacement of fluid and electrolytes, but in more severe cases where the stenosis is due to firm scarring surgery is usually indicated and may yield most gratifying results Successful relief of mechanical obstruction of this type adds enormously to the comfort and nutrition of the patient

HAEMOPOIETIC SYSTEM

Accurate diagnosis based on blood examination and other relevant tests is an essential prerequisite to treatment. Correction of anaemia is readily achieved in many cases and is a great asset in improvement of health in the elderly, particularly in those afflicted with cardiovascular disease.

Pernicious anaemia

Modern treatment is with vitamin B_{12}, which is definitely preferable to the older liver extracts (Blackburn and his colleagues, 1952). The latter are variable in composition but depend for their activity on their vitamin B_{12} content (Girdwood, Carmichael, and Woolf, 1950). The injection of liver is greater in volume, more liable to cause sensitivity reactions, and less reliable in action. In pernicious anaemia the body stores are depleted of the vitamin and the initial dosage should be kept large, of the order of 200 micrograms per week. Thereafter blood examinations should be carried out regularly and maintenance doses given at least at monthly intervals.

Preparations containing vitamin B_{12} with intrinsic factor have recently been introduced for the oral treatment of pernicious anaemia. Elderly patients particularly appreciate avoiding injections, but unfortunately these preparations are not so certain in their action as parenteral vitamin B_{12} (Blackburn, Cohen, and Wilson, 1955; Vilter, 1955). Their use at present cannot be recommended.

Iron deficiency anaemia

The first essential is to exclude chronic blood loss from such conditions as carcinoma, peptic ulceration and haemorrhoids. Anaemia secondary to an inadequate intake of iron in the diet is not uncommon in the elderly, particularly if they are living alone and fending for themselves.

Many satisfactory preparations are now available for administration by mouth. The most suitable are ferrous sulphate or ferrous gluconate, both in a dose of about 0.4 gramme thrice daily. The latter is reputed to cause less gastro-intestinal irritation, which can be a troublesome complication of iron therapy in elderly patients. Occasionally cases are met in whom a satisfactory response is not obtained owing to defective intestinal absorption. Intravenous iron therapy with saccharated oxide of iron (Ferrivenin) is then indicated (Nissim, 1947).

In severe cases with cardiac failure admission to hospital is indicated and a transfusion of packed cells should be given slowly under careful supervision.

It should be emphasized that in all cases an attempt must be made to correct the cause underlying the development of the iron deficiency anaemia. This may mean attention to gastro-intestinal lesions but often in the elderly the condition is nutritional in origin due to poverty, loneliness associated with disinclination to prepare adequate meals, unsatisfactory cooking facilities and dietary prejudices. It is important to note the extent to which the addition of foodstuffs rich in ascorbic acid enhances the absorption of iron from the diet (Moore and Dubach, 1951). The doctor should emphasize to these patients the necessity for an adequate supply of meat and vegetables.

ENDOCRINE SYSTEM

Disorders of the islets of Langerhans and of the thyroid gland are relatively common in old age, but otherwise apart from prostatic disturbances, the endocrine system is remarkably free from disease It is, of course, a popular belief that many of the changes of old age can be attributed to a decline in endocrine function and many doses of sex hormones have been given in the vain hope of achieving rejuvenation There is now reliable evidence that in healthy old age adequate function of the pituitary, thyroid and adrenal cortex is preserved so that there is no disproportion between the supply of internal secretions and the requirements of the tissues Indeed it is a striking feature that Addison's disease, commonly due to a primary atrophy of the cortex, develops usually in adolescence or early adult life and not in old age The occurrence of the menopause in women and of a gradual depression of sexual function in the male should be regarded as normal processes not usually requiring therapeutic intervention The decrease in the internal secretions of the sex glands develops with the passage of years and the available evidence suggests that this change should be regarded as concomitant with rather than causal of the ageing process It accordingly follows that apart from a few specialized uses (such as in senile osteoporosis or prostatic cancer) to be described elsewhere, there is little indication for the widespread use of sex hormone therapy in old age The treatment of diabetes mellitus has been discussed in Chapter 6

Thyroid

Disorders of this gland are of considerable importance in that for the most part they respond well to treatment Hyperthyroidism as a causal or aggravating factor in heart disease has already been mentioned Treatment with radioactive iodine constitutes a great advance, particularly in the elderly and enfeebled as no patient is too ill to drink a therapeutic dose of ^{131}I The tech

have been described by seve

Abbatt and Stewart, 1954)

of the radiation in produc[illegible] normal thyroid function as four to five months are required, but this is greatly outweighed by the greater safety of the procedure in comparison with surgery In patients whose clinical condition demands rapid control of the thyrotoxicosis antithyroid drugs may be given in the first instance, to be followed later by radioactive iodine There can be little doubt that radioactive iodine is the most satisfactory method for treating the elderly thyrotoxic patient, particularly if cardiac complications are also present Determination of the precise dosage required to produce euthyroidism presents some difficulties and in a small proportion of cases hypothyroidism eventually develops This is readily controlled [illegible]

[illegible] ity of an aged patient to fend for

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The doctor should emphasize to these patients the necessity for an adequate supply of meat and vegetables

Treatment

In treatment Cooke has stressed certain important measures The patient should not be allowed to linger in bed but should be encouraged to get up at the earliest opportunity, even if only to sit in a chair The normal stresses and strains induced by activity are essential to stimulate bone formation If there is much pain in the [illegible]

sex hormone is also required and is most conveniently prescribed as ethinyl oestradiol 0 1 milligram daily by mouth Treatment must be continued over a long period probably for at least two years but it may be intermittent, such as four weeks on and two weeks off treatment, particularly if undesirable side effects develop The chief complications are the occurrence of masculinizing effects of the androgen therapy in females and of uterine bleeding as a result of oestrogen in post menopausal women They can be reduced to a minimum by the use of small doses and rest periods Relief of pain is striking in successful cases and in some, definite radiological improvement may be observed after prolonged therapy (Albright and Reifenstein 1948)

Rheumatoid arthritis

While this is a disease that commonly develops in early or middle adult life, it may begin after the age of 60 years It is however, a frequent cause of disability in old age as by this time the affected joints are commonly grossly disorganized

Treatment

Treatment must vary according to the stage of the disease at which the patient is seen When the disease has passed into an inactive form but has left considerable deformity of the limbs and incapacity, the aim of therapy must be to increase the range of movement at the joints

Exercises —Particular attention must be paid to exercises designed to cover activities required by the patient for his own day to day care Movements at the shoulder and elbow are especially important for eating and dress[illegible]

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[illegible] in effective doses 0 3 1 0

himself, yet may be corrected by treatment This is carried out either with thyroid extract or L-thyroxine sodium The initial dose of either preparation should be small (*thyroid extract, ½ grain per day, or thyroxine sodium 0 05 milligram per day*), and gradually increased to obtain an optimum effect The development of palpitations, diarrhoea or angina indicates that the dose is excessive

Thyroid function and heart disease

The relationship of thyroid function to heart disease is of considerable importance (Andrus, 1953) The conspicuous and often lasting relief of congestive cardiac failure or of angina pectoris observed after successful treatment of thyrotoxicosis has led to the artificial induction of hypothyroidism for the treatment of intractable heart disease occurring in patients with normal thyroid function Prior to the introduction of antithyroid drugs and radioactive iodine, total thyroidectomy was carried out for this purpose The operative mortality was 10 per cent in those with congestive failure and 5 per cent in those with angina pectoris Considerable improvement was achieved in over half the patients treated in this way (Parsons and Purks, 1937) The operative mortality has been eliminated by the use of ^{131}I, and several more recent reports are available describing the results achieved by this agent Blumgart and his associates (1951) reported no untoward reactions arising from the treatment of 37 euthyroid cardiac patients One third of the patients gained considerable benefit and another third showed worthwhile improvement The remaining third obtained no benefit It is clear that in a proportion of cases much relief can be obtained by reducing thyroid function in patients with severe heart disease *This particularly applies in the older age groups* in whom the condition is so commonly secondary to established atherosclerotic arterial disease, which in itself cannot be remedied One argument sometimes advanced against this form of therapy is that it may accelerate the development of atherosclerosis The evidence on this point in man is inconclusive (Andrus, 1953) In eight patients made hypothyroid for several years (mean 7 4) for therapeutic reasons, Blumgart and his associates found no significant difference in the state of the arteries compared with those of euthyroid individuals

The induction of myxoedema should not be undertaken lightly and clearly this form of treatment should be reserved solely for those severely disabled who have not responded to other forms of treatment In them the response of the heart to treatment with antithyroid drugs may be ascertained first and if this is favourable, permanent hypothyroidism may later be achieved with ^{131}I

LOCOMOTOR SYSTEM

Osteoporosis

Cooke (1955) has recently drawn attention to the importance of this condition It is one of the few disorders associated with ageing which is, at least partially reversible The condition at all ages is six times as common in women as in men There is probably no definite distinction between the so-called post-menopausal and senile osteoporosis and there is good evidence for an endocrine factor in the pathogenesis of the disorder

Treatment

In treatment Cooke has stressed certain important measures The patient should not be allowed to linger in bed but should be encouraged to get up at the earliest opportunity, even if only to sit in a chair The normal stresses and strains induced by activity are essential to stimulate bone formation If there is much pain in the

sex hormone is also required, and is most conveniently prescribed as ethinyl-oestradiol, 0 1 milligram daily by mouth Treatment must be continued over a long period, probably for at least two years, but it may be intermittent, such as

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Treatment

Treatment must vary according to the stage of the disease at which the patient is seen When the disease has passed into an inactive form but has left considerable deformity of the limbs and incapacity, the aim of therapy must be to increase the range of movement at the joints

Exercises—Particular attention must be paid to exercises designed to cover activities required by the patient for his own day to day care Movements at the shoulder and elbow are especially important for eating and dressing

Aspirin—During acute exacerbations the two chief considerations are the relief of pain and the prevention of deformities as there is no

in effective doses, 0 3–1 0 gramme which may be repeated every three or four hours during acute exacerbations The main disadvantage is the liability to produce epigastric distress, nausea and vomiting These side effects are probably partly central in origin as they appear after intravenous administration of salicylate, and

without the appearance of salicylate in the gastric juice (Graham and Parker, 1948) Idiosyncrasy to aspirin usually shows itself in the form of skin rashes and anaphylactic reactions The incidence of sensitivity to aspirin is low (Goodman and Gilman, 1955), but it is important to recognize the condition as it may on occasion cause much distress

Cortisone and allied steroids—The ultimate place of cortisone and allied steroids in the treatment of rheumatoid arthritis has not yet been determined As, however, they are becoming more freely available they will undoubtedly be used in greater amounts in the treatment of this disease Cortisone does not remove the underlying disease process and, after stopping the treatment, relapse commonly occurs Moreover, it is of no avail in patients suffering from the end results of the disease, such as ankylosis and gross deformity of the joints Cortisone acts chiefly by virtue of its anti-inflammatory effect and may produce striking immediate clinical improvement The long-term results are *probably not so encouraging* but have not as yet been fully determined Cortisone is probably chiefly of value in acute cases where inflammation and pain are severe and are not controlled by aspirin

Treatment with cortisone should not be undertaken lightly (Bayliss, 1955) *It is liable to produce undesirable side effects and it is difficult to stop the drug* once it has been begun The initial dose is usually 100 milligrams daily by mouth

months As soon as possible the dose should be reduced to an amount sufficient to maintain as much improvement as possible without the development of the undesirable features of cortisone therapy This is extremely variable but usually lies in the range *25–75 milligrams per day During exacerbations an increase in* dose may be required as a temporary measure *If* a remission occurs the dose of cortisone should be reduced gradually and finally omitted if possible

The commonest undesirable side effects in elderly patients in whom the cardiovascular reserve *may be diminished are electrolyte disturbances oedema and* hypertension *These* usually only appear if the dose is maintained over 75 milligrams per day for long periods A low sodium diet supplemented with 2 3 grammes of potassium chloride daily should be given in these circumstances Other complications and side effects of cortisone therapy are the masking of infections such as pneumonia, the spread of previously quiescent tuberculous foci and the activation or development of peptic ulcers Some degree of osteoporosis is invariably present in elderly patients and may be severe in those partially immobilized by rheumatoid arthritis *Cortisone by causing an enhanced nitrogen excretion* may itself *lead to* osteoporosis The sudden increase in activity consequent on cortisone therapy combined with these factors may result in spontaneous fractures In old patients, particularly if they have been immobilized for a long period careful supervision of the amount of exercise in the early stages of treatment is clearly indicated Mental disturbances are occasionally seen during cortisone therapy A sense of euphoria is common at the onset of treatment and there may be insomnia Psychotic disturbances may appear, particularly in those showing some mental instability *beforehand These usually subside when cortisone is* stopped

The complication of salt and water retention may be eliminated in future by the prescription of the new steroids, prednisone and prednisolone, which have a similar anti inflammatory action to cortisone in about one quarter to one fifth of the dose, but a greatly diminished liability to cause oedema (Nabarro, Stewart and Walker, 1955) The other side effects appear similar to those of the parent substance (Editorial, Lancet, 1955) These substances clearly constitute advances of great interest though the exploration of their therapeutic uses and limitations is still in an early stage

Phenylbutazone—Another innovation in the field of treatment of rheumatic and allied disorders is the introduction of phenylbutazone (butazolidin) It was enthusiastically received as in adequate dosage it provided symptomatic relief in the majority of patients with rheumatoid arthritis and allied disorders A specific action apart from its analgesic effect has not been demonstrated and symptoms recur shortly after withdrawal of the drug It has serious toxic effects and their incidence increases with age (Pemberton, 1954) Digestive disturbances, reactivation of peptic ulcer, skin rashes, agranulocytosis and thrombocytopenia have all

... high incidence of serious toxic reactions and complications, and the lack of any proven superiority over other less harmful analgesic agents make it doubtful whether this drug will achieve a permanent place in the treatment of arthritic disorders in the elderly (Brodie and his colleagues, 1954)

Gout

There is no treatment that removes the underlying metabolic abnormality but several measures are available for the relief of symptoms and for promoting excretion of uric acid During an acute attack rest in bed is required and the ...
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ever
Usu
stop

... to 6 milligrams ... inflammation abate within twelve hours and are completely gone in two days With experience the amount required to control an exacerbation is learnt in each patient and can rapidly be given at the onset

Colchicine should also be taken regularly by persons with ...
to recurrent attacks ...
range 0
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renal or gastro intestinal disease ... to aged patients with cardiac, It may be combined with salicylates which increase uric acid excretion and lower the blood uric acid level, but to be effective,

doses of salicylates above 5 grammes per day must be given and these are rarely tolerated by old people for long periods. However, control of the disease has been achieved by prolonged salicylate administration (Marson, 1955) The action is increased if sodium bicarbonate is given at the same time, in spite of the tendency of the alkali to lower plasma concentrations Ample fluids should be given to guard against precipitation of urates in the renal tubules. Probenecid has a similar uricosuric action and is better tolerated It is probably preferable for the long-term management of chronic gout It is usually given in a dose of 0·5 gramme to 2 0 grammes per day. The effect of a single daily dose of 0·5 gramme is ascertained in the first week Thereafter larger amounts may be given by increasing the frequency of doses up to four times a day. *Salicylates should* not be given concomitantly as they interfere with the renal action of probenecid After the patient has been stabilized on probenecid, dietetic restriction need not be severe and only foods exceptionally high in purine need be avoided (Bishop and Talbott, 1953, Gutman and Yu, 1952)

HORMONE THERAPY OF INOPERABLE CARCINOMA

The claims for relief of carcinoma by administration of sex hormones are almost entirely related to carcinoma of the prostate and breast It must be emphasized that this method does not displace operative removal of the tumour, which is clearly the first method of treatment Hormone therapy may be used in those cases where extensive local spread or the development of metastases has rendered the neoplasm inoperable or unsuitable for treatment by radiotherapy

Carcinoma of the prostate

In carcinoma of the prostate the aim is to diminish the release of androgen (Huggins, Stevens, and Hodges, 1941) There is the choice of either orchidectomy or the administration of oestrogens or a combination of both measures (Nesbit and Baum, 1950) There is as yet insufficient evidence from controlled trials to decide which is the most effective Stilboestrol is the commonly prescribed agent. It may be implanted as a 100-milligram pellet about every four months or given by mouth Small doses are probably as satisfactory as massive ones and usually 5 to 15 milligrams per day is given, but the range that has been used is wide and *has extended from 1 milligram up to 1 gramme daily* Some improvement soon follows suppression of androgen secretion This is shown chiefly by relief of pain and an associated increase in appetite and general health Unfortunately the relief is generally only temporary and the tumours become insensitive after a variable period However, it is now established that treatment with stilboestrol does significantly prolong life

Carcinoma of the breast

In the palliative treatment of carcinoma of the breast both oestrogens and androgens have been used The former should only be used in women who have had their menopause at least five years previously Oestrogens may accelerate the rate of growth of the tumour in pre-menopausal and menopausal women The most favourable results are seen in elderly women with soft tissue metastases

Stilboestrol is most commonly used for this purpose in a dose of 15 milligrams daily but probably other oestrogens in equipotent doses are equally effective (American Medical Association Committee, 1951, Kennedy and Nathanson, 1953) Therapy must be continued for two to three months before definite improvement is

appear

with cor

by subcutaneous implantation Uterine bleeding may develop as the result of prolonged oestrogen therapy Treatment should be discontinued temporarily and resumed after bleeding has ceased Four injections of progesterone, 25 milligrams, should then be given on alternate days once a month to induce a progesterone withdrawal bleeding This will simulate a normal menstrual period and prevent the tendency to severe metropathic bleeding (Bishop, 1954)

Androgen therapy may be given to women in any age group. It is the hormone of choice in the treatment of bony metastases Objective evidence of regression of metastases is occasionally seen but symptomatic relief is usually forthcoming Androgens may be given as testosterone propionate, 50 to 100 milligrams thrice weekly by injection, or as methyltestosterone, 100 to 200 milligrams daily by mouth Side effects and virilizing features may appear but again are perhaps less frequent in older women than in pre-menopausal patients

A toxic manifestation that may appear with either oestrogens or androgens

...ation is an indication for at least temporary withdrawal of treatment

In assessing the results of hormone therapy of carcinoma of the breast

...nausea at the outset Androgens cause considerably more distress with their virilizing effects and disturbing influence on libido and are of most benefit in relieving pain from bone metastases There is as yet no definite statistical evidence that hormone therapy prolongs life

NERVOUS SYSTEM

Relief of pain

...drugs, there are a large number of these, several new ones having been introduced within recent years For severe pain morphine

doses of salicylates above 5 grammes per day must be given and these are rarely tolerated by old people for long periods However, control of the disease has been achieved by prolonged salicylate administration (Marson, 1955) The action is increased if sodium bicarbonate is given at the same time, in spite of the tendency of the alkali to lower plasma concentrations Ample fluids should be given to guard against precipitation of urates in the renal tubules. Probenecid has a similar uricosuric action and is better tolerated. It is probably preferable for the long-term management of chronic gout It is usually given in a dose of 0·5 gramme to 2·0 grammes per day The effect of a single daily dose of 0·5 gramme is ascertained in the first week Thereafter larger amounts may be given by increasing the frequency of doses up to four times a day Salicylates should not be given concomitantly as they interfere with the renal action of probenecid After the patient has been stabilized on probenecid, dietetic restriction need not be severe and only foods exceptionally high in purine need be avoided (Bishop and Talbott, 1953, Gutman and Yu, 1952)

HORMONE THERAPY OF INOPERABLE CARCINOMA

The claims for relief of carcinoma by administration of sex hormones are almost entirely related to carcinoma of the prostate and breast It must be emphasized that this method does not displace operative removal of the tumour, which is clearly the first method of treatment Hormone therapy may be used in those cases where extensive local spread or the development of metastases has rendered the neoplasm inoperable or unsuitable for treatment by radiotherapy.

Carcinoma of the prostate

In carcinoma of the prostate the aim is to diminish the release of androgen (Huggins, Stevens, and Hodges, 1941) There is the choice of either orchidectomy or the administration of oestrogens or a combination of both measures (Nesbit and Baum, 1950) There is as yet insufficient evidence from controlled trials to decide which is the most effective Stilboestrol is the commonly prescribed agent It may be implanted as a 100-milligram pellet about every four months or given by mouth Small doses are probably as satisfactory as massive ones and usually 5 to 15 milligrams per day is given, but the range that has been used is wide and has extended from 1 milligram up to 1 gramme daily Some improvement soon follows suppression of androgen secretion This is shown chiefly by relief of pain and an associated increase in appetite and general health Unfortunately the relief is generally only temporary and the tumours become insensitive after a variable period However, it is now established that treatment with stilboestrol does significantly prolong life

Carcinoma of the breast

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Pethidine hydrochloride.—Pethidine hydrochloride (meperidine hydro-chloride) has a definite analgesic action This is not so potent or prolonged as that of morphine but it is less liable to cause unpleasant side effects It may occasionally produce nausea, dizziness and dryness of the mouth It is also widely reported to have an antispasmodic action but this effect is extremely variable (Goodman and Gilman 1955) The usual effective dose is 100 milligrams and this, given by intramuscular injection, procures relief of pain within a quarter of an hour It is also active by mouth It has a mild sedative action but is not a potent hypnotic Tolerance to the drug does not readily develop but cases of addiction are being reported in increasing numbers Pethidine is frequently substituted for morphine and has the advantage of not causing respiratory depression, urinary retention, constipation and confusion—all points of considerable importance in elderly patients

Methadone hydrochloride.—Methadone hydrochloride has approximately the same analgesic effect as morphine in equal dose An average dose is accordingly about 10 milligrams It is less liable to cause nausea, vomiting and respiratory depression but does not have such a powerful sedative action as morphine It has a slight constipating effect and may cause biliary tract spasm The duration of action is longer than that of morphine It is better absorbed when given by mouth but gastric disturbances are more frequent with medication by this route Methadone has some action in suppressing cough but is a drug of addiction so that codeine should al... [illegible]
is [illegible]
me [illegible]
pr [illegible]

Levorphan.—Levorphan closely resembles morphine both in chemical composition and pharmacological action It is more potent on a weight basis than morphine as an analgesic and the average dose for an elderly patient is 2 milligrams by subcutaneous injection or by mouth The early claims for this drug have not been substantiated and it does not appear to have any therapeutic advantage over morphine (Jaggard, Zager, and Wilkins, 1950) The incidence of side effects from the two substances is similar when they are given in corresponding pharmacological doses The liability to the development of addiction is likewise comparable

Chlorproma... [illegible]
with actio [illegible]
cally to th [illegible]
among ph [illegible] ...with central depressant activity Chlorpromazine is chiefly used in therapeutics for its depressant, sedative and anti-emetic effects It is of value in the treatment of states of delirium confusion and agitation irrespective of the underlying psychopathology It enhances the action of analgesics and produces a certain degree of indifference to pain, features of particular value in treating patients with ad... [illegible]

[illegible] ...usual dose [illegible] ...two to four times a day by mouth but much larger doses may be required Various undesirable side effects and toxic reactions

is still pre-eminent, it not only provides relief from pain but allays apprehension and restlessness in a manner that can be achieved by no other drug or combination of drugs. For an analgesic the choice lies between a member of the aromatic group, such as aspirin, a member of the opium group and its derivatives, or one of the new synthetic drugs such as pethidine, methadone or levorphan.

Aspirin

Little need be said about the older analgesics. They are cheap and effective but have certain disadvantages. The nature of some of these undesirable side effects has been more fully elucidated by recent work. Aspirin is relatively non toxic, but, particularly in elderly patients, may give rise to gastric disturbances. These may be due partly to a central action but they can be reduced if the drug is taken after food or with some milk, and soluble aspirin tablets are used.

Phenacetin

Phenacetin is a useful substitute for aspirin and is less irritant to the gastric mucosa. Its chief disadvantage is its liability to cause methaemoglobinaemia. The cyanosis may be mistaken as a sign of cardiac or pulmonary disease and the drug continued. There is considerable individual variation in susceptibility to the toxic effect of phenacetin and chronic poisoning is not uncommon in the elderly. The chief toxic features are cyanosis, shortness of breath, severe weakness, anorexia, dyspepsia and insomnia. It will be readily appreciated how the significance of these complaints may be overlooked in an elderly patient, especially if the drug is being consumed in a self-administered proprietary remedy.

Combinations of analgesics

In recent years many combinations of analgesics have been made available in single tablet or capsule form by the manufacturers of proprietary remedies in the hope of producing a synergistic effect. The compound tablet of codeine is probably the best known and most widely used. It contains 0·25 gramme (4 grains) each of aspirin and phenacetin and 8 milligrams (⅛ grain) of codeine. Two compound codeine tablets thus contain more aromatic analgesic than three (0·33 gramme or 5 grain) aspirin tablets quite apart from the codeine. In many cases the alleged greater efficiency of the compound tablet is solely a matter of dosage and the additional drug. In general it is advisable to avoid using compound tablets and to preserve flexibility of control by variation of the dose of the individual substances to suit the patient. A particular warning should be given against the use of proprietary compounds containing amidopyrine, which is an occasional cause of agranulocytosis.

Synthetic analgesics

Several synthetic analgesics have been prepared in recent years. They have been introduced in the hope of providing preparations as effective in relieving pain as morphine but with fewer side effects and less liability to produce addiction. This has not as yet been achieved but there is no doubt that increasing use is being made of these new derivatives.

milligrams three or four times daily Some patients cannot tolerate fully effective doses owing to the development of headache, giddiness, visual disturbances, dry mouth and gastric disorders In half to three quarters of patients some favourable effects may be obtained, but well-controlled clinical trials are still required to determine its usefulness Other new agents introduced for the treatment of this disorder include diethazine and a closely related substance, ethopropazine hydrochloride The former has occasionally given rise to agranulocytosis and renal injury and both must clearly be used with caution There is no evidence that they are more effective than other less toxic substances available for the relief of parkinsonism Antihistamine drugs, particularly diphenhydramine (Benadryl) have been employed with some success (Budnitz, 1948) but their mechanism of action has not yet been determined

It is important to appreciate both the limitations and advantages of drug treatment of this condition A small degree of improvement can be obtained in most patients It is often advisable to use a combination of drugs (Effron and Denker, 1950) and the best arrangement and doses have to be determined for each individual patient

Though the aid given by drugs may be small it is in many cases sufficient to restore an incapacitated patient to some degree of activity so that he may become ambulatory and able to look after himself

Surgical treatment

Recently, efforts have been made to treat parkinsonism surgically The results are best in younger patients and it is doubtful whether this form of treatment will help the elderly, in whom the disorder is usually bilateral and progressive

Cerebral atherosclerosis

In comparison with coronary artery disease relatively little attention has been paid to factors leading to degenerative changes in cerebral arteries and it must be admitted that very little progress has been made in the medical treatment of cerebrovascular disorders The effects of a cerebral thrombosis resulting in hemiplegia may be partially overcome by careful rehabilitation of the patient as described in other chapters The drugs described for th
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olazoline, have been unsuccessful
(Clarke and his colleagues 1954) The use of anticoagulant drugs has been recommended in the treatment of cerebral arterial thrombosis but is not generally accepted in view of the difficulty in d
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and therapeutics

have been described (Giacobini and Lassenius, 1954) These include postural hypotension, dryness of the mouth, skin rashes and disturbances of the extrapyramidal nervous system The most serious common toxic effect is the development of jaundice This occurs in about 1 per cent of patients receiving the drug There is no definite correlation between the amount taken and the occurrence of jaundice This complication varies greatly in severity and may even prove fatal Older people are more likely to develop jaundice than young ones, and females more than males (Isaacs, Macarthur, and Taylor, 1955) Chlorpromazine is a potentially dangerous drug It has several useful actions, particularly in supplementing the action of analgesics, but clearly its administration should not be undertaken for trivial reasons

Insomnia

This is a common complaint in the aged It is important to recall that they often do not tolerate well depressant drugs such as barbiturates, and simple measures should always be tried in the first instance before having recourse to hypnotic agents Quiet surroundings, warmth in bed and reduction of extraneous noise have long been recognized as important in procuring sleep Chloral hydrate is a valuable hypnotic in the elderly and is a useful alternative to the barbiturates Bromides should not be given along with it as they have no hypnotic effect in the usual single dose but may, if repeated, accumulate in the body and lead to intoxication and mental derangement Barbiturates are widely used and in the majority of cases produce no undesirable side effects They should, however, be given in a small dose in the elderly, particularly as occasionally they may produce excitement instead of sleep

Alcohol in moderation can serve as a valuable sedative and hypnotic for the elderly It is doubtful if its vasodilating action is of any importance in those with cold feet or ischaemic pain in the lower limbs due to atherosclerotic arterial disease Nevertheless, some alcohol at night may dull the appreciation of pain and permit a few hours of restful sleep On the other hand, the abuse of alcohol may be exceedingly injurious particularly if it leads to inadequate protein in the diet, malnutrition and vitamin deficiencies

Parkinsonism

In old age this condition is usually of degenerative origin and is not complicated by the mental defects which may result from virus encephalitis The disease is chronic and progressive and treatment is essentially symptomatic Drug therapy may assist other measures which consist mainly of physiotherapy and encouragement Drugs of the belladonna group, such as stramonium and hyoscine, have been used for long in the relief of this condition and are probably at least as effective as the synthetic drugs which have been recently introduced These new substances act centrally as skeletal muscle relaxants and their aim is to abolish the spasticity and tremor seen in parkinsonism without interfering with normal muscular tone and movement Benzhexol hydrochloride has been fairly widely used and is relatively free from untoward side effects Small initial doses are used, about 1–2 milligrams twice a day, and the amount is increased gradually to 3–4

milligrams three or four times daily Some patients cannot tolerate fully effective doses owing to the development of headache, giddiness, visual disturbances, dry mouth and gastric disorders In half to three-quarters of patients some favourable effects may be obtained, but well-controlled clinical trials are still required to determine its usefulness Other new agents introduced for the treatment of this disorder include diethazine and a closely related substance, ethopropazine hydrochloride The former has occasionally given rise to agranulocytosis and renal injury and both must clearly be used with caution There is no evidence that they are more effective than other less toxic substances available for the relief of parkinsonism Antihistamine drugs, particularly diphenhydramine (Benadryl) have been employed with some success (Budnitz, 1948) but their mechanism of action has not yet been determined

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The complications arising from atheromatous disease in the cerebral arteries constitute one of the major causes of disability in the elderly The patho-[illegible]

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CHAPTER 13

NUTRITIONAL PROBLEMS OF THE ELDERLY

H M SINCLAIR

INTRODUCTION

FROM the earliest times man has been interested in the proper sorts and amounts of [illegible]

persons use less nutriment than young" and therefore they could produce such quantitative rules as 'Growing persons have most innate heat, and therefore require most nourishment otherwise their bodies will waste away, whereas old people have but little heat and therefore require only a small quantity of aliment for too much would extinguish the little heat they have remaining" In his celebrated *Code of Health and Longevity* my great grandfather, Sir John Sinclair, listed 1,420 foreign books published upon the subject of diet and longevity, and these he abstracted together with British works, he reasonably concluded a century and a half ago that people wrote too much "Such immense masses of printed paper can answer no good purpose, and are a heavy load upon literature and the acquisition of useful knowledge'

Probably the most celebrated of these authors was the Venetian nobleman, Luigi Cornaro, who led a riotous youth the excesses of which so injured his health that he was forced to adopt a strict regimen of temperance At the ages of eighty-three, eighty six, ninety one and ninety five he wrote treatises extolling the virtues of sobriety his death when over 100 years old put an end to these tiresome encomiums

Through[illegible] runs the same advice, that is to avoid ex[illegible] leasures and passions, and avoid worry or [illegible] of the three long lived Chinese emperors Hang Vu Ti practised moderation in food, Song Kau Tfong let nothing ruffle his temper Lyang Vu Ti attributed his longevity to having lain for thirty years in an apartment separate from his wives, a practice also recommended by the Chinese Methuselah, Peng K'eng, who remarked that a gentleman sleeps in a separate bed from his wife

Though the authors of the 16th to 18th cent[illegible]

[illegible] was in its infancy The 19th century produced great advances in this science In the earlier part of the century the aliments protein, fat carbohydrate, were differentiated, and towards the middle of the century the importance of protein came to be realized largely through the

work of Liebig Then in the second half of the century intermediary metabolism began to be elucidated, and advances in chemistry made possible the analysis of dietaries and metabolic studies that for the first time indicated nutritional requirements At the end of the century vitamins were discovered, and studies upon these have occupied much of the first half of the present century. The realization that the growing body had unusually high nutritional requirements and interest in the remarkable effect of nutritional deficiencies upon growth tended to concentrate work upon the earlier periods of the life-span.

Study of nutritional problems in the elderly

It is only very recently that general attention has been paid to nutritional problems peculiar to the elderly The main reason for this recent turn of interest is the increasing number of old persons in the population For instance, in the United States the median age of the population in 1900 was just under 23 years, in 1950 was just over 30 years, and in 1975 is expected to be 34 years (Mountin, 1950)

Difficulties

The study of nutritional problems in the elderly has therefore become, and is becoming, increasingly important Such studies are facilitated by one fact and impeded by three The old are in general an easy group to study, a small proportion of them can be found living together in homes and greatly appreciate intelligent interest taken in them and co-operate in studies upon them to an extent that is greater than the mere desire for relief from boredom

A difficulty is the variability of the old Infants are comparatively uniform in size and metabolic pattern, but as age advances deviations from the norm become increasingly apparent and therefore in old age relatively extensive studies are required to establish the norm and differences between groups A cause of this variability, but sufficiently important to be separately mentioned as the second difficulty, is the presence of the scars of past malnutrition or other disease These may continue to impair function or may warp one's judgment about the present state, for example, one is biased as soon as one sees an old person with rachitic deformities which may not, however, affect the present state of health The mental impairment or confusion of the old often impedes study of their nutritional problems

The third difficulty is the decision when ageing starts, or at what chronological or physiological age a person is described as elderly (Medawar, 1955, Comfort, 1955) Obviously individual cells are ageing at birth, red blood corpuscles and cells of the epidermis are continually getting older, degenerating, and disintegrating or being disintegrated Ageing in the sense of the start of senescence might be supposed to start with the end of adolescence or when growth ceases, alternatively it might be supposed to start at the climacteric

The studies of Sonneborn with a flatworm (*Stenostomum incaudatum*), of Lansing with a rotifer (*Philodina citrina*) and of McCay with rats and other animals give strong biological grounds for dividing the span of life into the three periods of infancy, adolescence and senescence, senescence starts when growth ceases For our present purposes, however, we may arbitrarily assume that

the elderly are more than 45 years of age In passing we should note that the studies upon lower organisms establish the important principle that prevention of maturation as by under nutrition may almost completely inhibit senescence For instance McCay has shown with trout and rats that over nutrition during the growing period shortens the life span and under-nutrition prolongs it (McCay, 1955a and b) From this and other work the important conclusion follows that it is dangerous to over feed children, a subject that I have discussed elsewhere (Sinclair, 1955a) and one which being not directly germane to the present discussion will not be considered here further Some old persons are obese, and some persons who were obese at a period of their lives live to great ages Dublin (1953) has brought forward evidence in support of the view that fat people who lose weight live longer, and I myself have discussed the dangers of over feeding at the recent Congress of the International Association of Gerontology (Sinclair, 1955c)

DIGESTION AND ABSORPTION

Teeth

Appetite often becomes dulled in old age, partly because of diminution in the senses of smell and taste though these senses may remain very acute As a cause of loss of teeth in the elderly, caries becomes less important with ageing and periodontal diseases become more important Loss of teeth and attrition change the shape of the jaws and face and cause difficulty in eating Therefore food may not be properly masticated with ensuing irritation of the bowel, and soft foods may be chosen ...

... poor restorations Sicher (1948) has reviewed the effects of these disturbances which may be followed by deforming arthritis and pain in mastication

Effects of wearing upper denture

Two effects of wearing an upper denture may be noted First, it may induce chafing of the corners of the mouth and this angular stomatitis may be mistaken for evidence of defic...
tion of the
adequately
his old pati

Saliva

... Hampert (1937) has described

large degenerate cells in the salivary glands of the elderly; these he called "oncocytes". Meyer and colleagues (1937; 1940) have demonstrated that the production of saliva and the ability to digest starch are diminished after the age of sixty. Since the elderly consume relatively more carbohydrate the deficiency of saliva might be expected to be a cause of indigestion, but pancreatic amylase was found to be undiminished (Necheles, Plotke and Meyer, 1942).

Achlorhydria

Incidence

So-called "chronic atrophic gastritis" is common after the age of fifty years (Hebbel, 1949), its causes and consequences have been discussed by Faber (1935) Associated with it is achlorhydria the incidence of which increases with advancing age (Bloomfield and Polland, 1933) There is a similar decline in total acid secreted in both sexes, and the incidence of achlorhydria is only slightly lower after the Ewald test-meal than after histamine (Table XXV)

TABLE XXV

PERCENTAGE INCIDENCE OF ACHLORHYDRIA IN VARIOUS DECADES OF LIFE AFTER EWALD TEST-MEAL

Age	*Number of subjects*	*Number of cases of anacidity*	*Percentage with anacidity*
20–24	866	46	5 3
30–39	1,354	137	9 5
40–49	1,299	224	16 7
50–59	1,043	250	24 0
60 +	642	227	35 4
	5,204	884	16 9

(*After Bloomfield and Pollard* 1933)

Effects of achlorhydria

The effects of this achlorhydria are not properly known One important consideration is decreased absorption of B vitamins this and the possible decreased absorption of iron and calcium are discussed below Dyspepsia or "indigestion" was found to be a complaint of almost half the patients at the Mayo Clinic between the ages of thirty and sixty (Rivers, 1938), and the great danger of ignoring its importance or using nostrums to allay dyspeptic symptoms was demonstrated In patients over the age of 40 years who complained primarily of dyspepsia this was attributed in males to peptic ulcer in 23 per cent of cases, to cancer in 17 per cent (cancer of the stomach accounting for an overall 12 per cent), and to gall-bladder disease in 9 per cent, in females the cause was gall-bladder disease in 24 per cent of cases, pept c ulcer in 10 per cent, and cancer in 6 per cent (cancer of the stomach accounting for 4 per cent)

Meyer and his colleagues have shown (1940) that in the elderly amylolytic and lipolytic activity of the fasting duodenal contents is not much diminished whereas the proteolytic activity is markedly decreased

Intestinal absorption

Some information about intestinal absorption in the aged will be mentioned later in connexion with requirements and deficiencies of vitamins, but not much is available. Horvath, Wisotsky and Corwin (1947) found that in aged men there was no definite abnormality in the oral glucose tolerance test, but Meyer and his colleagues (1943) found a diminished peak in the oral galactose-tolerance test. The technique of administering a substance by mouth and measuring blood levels thereafter is apt to be misleading as a measure of intestinal absorption since tissue utilization may vary. Indeed this consideration led Smith and Shock (1949) to study blood levels of glucose after intravenous administration.

Half a century ago Metchnikoff proposed that ageing was caused by poisons derived from intestinal putrefaction. To avoid auto-intoxication removal of the colon was recommended and practised, and the intestinal flora was altered by copious draughts of suspensions of lactobacilli. Fortunately we now hold our bacterial flora in greater esteem.

TRANSPORTATION AND UTILIZATION

Nutrition is not concerned only with the eating of food, it is the process by which the cells of the body grow and obtain their energy. It is therefore concerned with the transport of oxygen, water, nutrients and aliments to the cells, with the utilization of these by the cells, and with the removal of waste products from the cells.

Circulatory insufficiency

Transport to the cells is impaired in circulatory insufficiency which is common in old age through cardiac inefficiency, arteriosclerosis or hypertensive arterial disease. The relation of diet to arteriosclerosis will be discussed presently. Circulatory insufficiency also impairs the removal of metabolic products from cells and little is known of the effects of chronic toxicity of these. Such effects may be enhanced by renal insufficiency, and it is therefore important to encourage a liberal fluid intake in the elderly; the kidneys do more work in excreting a small volume of highly concentrated urine than a large volume of dilute urine [illegible]

Homeostatic mechanisms of the body

The homeosta[illegible]

[illegible] by the glucose tolerance test

large degenerate cells in the salivary glands of the elderly; these he called "oncocytes". Meyer and colleagues (1937; 1940) have demonstrated that the production of saliva and the ability to digest starch are diminished after the age of sixty. Since the elderly consume relatively more carbohydrate the deficiency of saliva might be expected to be a cause of indigestion, but pancreatic amylase was found to be undiminished (Necheles, Plotke and Meyer, 1942)

Achlorhydria

Incidence

So-called "chronic atrophic gastritis" is common after the age of fifty years (Hebbel, 1949), its causes and consequences have been discussed by Faber (1935) Associated with it is achlorhydria the incidence of which increases with advancing age (Bloomfield and Polland, 1933) There is a similar decline in total acid secreted in both sexes, and the incidence of achlorhydria is only slightly lower after the Ewald test-meal than after histamine (Table XXV)

TABLE XXV

PERCENTAGE INCIDENCE OF ACHLORHYDRIA IN VARIOUS DECADES OF LIFE AFTER EWALD TEST-MEAL

Age	*Number of subjects*	*Number of cases of anacidity*	*Percentage with anacidity*
20-24	866	46	5 3
30-39	1,354	137	9 5
40-49	1,299	224	16 7
50-59	1,043	250	24 0
60 +	642	227	35 4
	5,204	884	16 9

(*After Bloomfield and Pollard*, 1933)

Effects of achlorhydria

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Meyer and his colleagues have shown (1940) that in the elderly amylolytic and lipolytic activity of the fasting duodenal contents is not much diminished whereas the proteolytic activity is markedly decreased

(Hooton 1951, Hooton and Dupertuis 1951) Sheldon (1954) gives supposed weights for heights at different ages of his various somatotypes almost all of which increase in weight until about 50 years of age and then decline For instance an extreme endomorphic mesomorph, 471 in Sheldon's terminology, of height 6 feet weighs 227 pounds at 18 years and gains about 20 pounds every five years up to the age of about 40 to 45 years as he gains body fat This gain in fat will then continue but he will start to lose muscle which is of course denser, and therefore his weight will decline if it is assumed that the water content of cells and extra-ce...
an
Tl
osteoporosis which again is probably due to loss of protein and reduced muscular activity

Measuring composition of body

... x rays of the calf, in general as age increased muscle decreased and fat increas...
texture than th...
Prentice and h...
different ages ... conclusion in each case was that there is a greater volume of fatty tissue at the higher ages Lowry and Hastings (1952) came to the startling conclusion that "A change in the water content of man's ...

... settled, especially as far as true senescence is concerned The data in this age range are too meagre However, the newer data on body water (and a variety of fatness indicators) suggest ...

20
we
22 ... 24 0 and 25 2 He c...
due solely to the increase
the increment in gross bo...
("fat free") body mass ... there was a decrement of the lean
Similar studies were made...
groups were taken w...
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... weight according to the 1952 height weight age standards ... 0, and 25 9 The men were ... height weight age standards whereas

If this is administered orally the changes observed might be caused by altered absorption from the intestine, and therefore Shock and his colleagues have used the intravenous glucose tolerance test in the aged (Smith and Shock 1949) The subjects were carefully selected to exclude anyone likely to have an altered response from any factor other than age No significant age trend in the resting blood sugar levels was found, but subjects aged 20 years returned to resting blood levels after 25 grammes of glucose intravenously more quickly than did subjects aged 80 years, there was a progressive increase in the time required to return to resting levels with increasing age This alteration might be caused by an impaired utilization of glucose within cells or to an altered secretion of insulin or some other hormone that effects the disposal of glucose The second explanation is perhaps more probable than the first but there is almost no evidence Liver tissue of lower animals, whether rats (Reiner, 1947) or guinea-pigs (Rafsky, Newman and Horonick, 1952), shows practically no change in rate of respiration with age On the other hand study of blood pyruvate following intravenous glucose appears to indicate normal secretion of insulin In a normal person the blood pyruvate rises, reaches a maximum after about 30 minutes and then falls reaching the resting level after a further hour In the diabetic the rise occurs much more slowly, does not reach so high a maximum and is still rising or is high after 90 minutes Elderly persons who were found to need a prolonged time (more than 120 minutes) for their blood glucose to return to normal after 50 grammes of intravenous glucose had rises and falls in blood pyruvate similar to those who needed less than 120 minutes and very different from patients with diabetes mellitus (Smith, 1950) It therefore appears that the delayed fall in blood glucose in the aged is not related to the delayed fall in diabetics

NUTRITIONAL REQUIREMENTS

Calories

Weight and height in old age

The body is composed of fat, bone, connective tissue, extracellular fluid and "active tissue" (such as muscles skin, glands, neurones) The changes in composition that occur with age have been very little studied, although it is common observation that they occur, we note more subcutaneous fat in infancy and in middle-age than is found at the end of adolescence and in old age In 1943 the Ministry of Food carried out a survey of height and weight of the civil population of Great Britain (Kemsley, 1950). It was found that males and females were tallest about the age of 22 years and decreased in height in old age, although it must be remembered that the numbers of elderly people studied were small Males were heaviest at about 37 years and females at about 52 years, body-weights falling in both sexes after these ages But when the weights were corrected for height there was a steady rise in weight in males, and a fall in females only after the age of 60 years (Kemsley, 1952) The interpretation of body-weights in old age is of course complicated by the greatly increased mortality of obese persons so that the chances of an over-weight person surviving to old age are diminished This may be a reason for the fall in weight after the age of 60 years seen in the Harvard Anthropological Survey of Ireland which was made upon the rural population in 1935

Scale of calorie allowance—In 1939 Stiebeling and Phipard put forward a scale of calorie allowances and proposed that a reduction of about 10 per cent should be made for persons between the ages of 60 and 75 years, and of about 20 per cent for those over 75 years During the war, the Oxford Nutrition Survey drew up for its own use a table of nutritional allowances (Sinclair, 1948b) These also give decrements in calories, and in vitamins of the B complex, in old age Calorie allowances were given for males aged 20 to 59 years for six different requirement classes and for females for five For those aged 60 years and over a

area but because ordinary daily activities are decreased Thus a man of 30 years doing moderately active work requires more calories than a man of the same height and weight of 60 years doing moderately active work partly because the former has greater non occupational activity and partly because he has a larger amount of active tissue as opposed to fat The Committee on Nutrition of the British Medical Association (1950) adopted all the calorie allowances of the Oxford Nutrition Survey with the single exception of making no distinction for persons of 60 years and over This was in conformity with the then current Recommended Dietary Allowances of the Nati[illegible]
for elderly persons In it
followed the Comm ttee

[illegible] 1948) no reduction in the allowance of calories in old age had been made

The Committee on Calorie Requirements of the Food and Agriculture Organisation made an important pronouncement which must be quoted at length

> It is commonly observed that people tend to eat less as they grow older if not they get fat. The few surveys that have been made on the food consumption of elderly people show that their calorie intake is substantially smaller than that of young adults living in the same environment Th[illegible]
> reduced energy expenditure of el
> basal metabolic state and in the
> body size decreases regularly afte [illegible] ities in men the relation between age
> and basal metabolic expend[illegible]
> is about
> rapid pa
> a tenden [illegible] ily activity with increasing age
> and the decline in energy expenditure for activity is likely to be proportionately more rapid than the decline in basal metabol[illegible] expenditure The Committee considered it
> [illegible] ale which allows for the effect of age on
> [illegible] more than the rough estimate that, for
> [illegible] calorie requirements may decline by 5 to 10 per
> cent For purposes of calculat on [illegible]

the women were slightly "under-weight". It is apparent therefore that in both sexes there is a marked increase in the percentage of fat in the body with increase in age from about 20 to about 55 years, and women maintain fairly uniformly a higher percentage of fat. A man of 55 years of standard weight for height and age has about the same percentage of body-weight as fat as a woman of 25 who is slightly "under-weight".

Metabolic rate and calorie requirements

Metabolic rate

The fact that there is a considerable increase in body-fat and to some extent a decrease in muscle as age advances during the period of maturity raises two important issues. First, what is to be regarded as the "normal" amount of fat and what represents obesity in the elderly, secondly, should the calorie requirements be decreased? We must first consider the metabolic rate of the body as affected by age, and here there are conflicting opinions as may be seen from the following three quotations from publications from the Laboratory of Physiological Hygiene in the University of Minnesota.

> This decrement [with age in non-fat tissues] accounts for a large part of the age differences in basal metabolism during maturity (Keys and Brožek, 1953).
>
> One kilogram of 'active tissue' appears to have a constant basal metabolism in the adult, regardless of age and sex (Keys, 1955).
>
> This [the presence of a difference between the basal oxygen consumption in reference to the values of active tissue mass in two groups of men aged 22–29 and 48–57] is an indication that ageing is associated with a real slowing down of the metabolic rate in the tissues (Brozek, 1952).

Whether there is a real slowing down or not has been investigated by Shock and others (Shock and Yiengst, 1955, Shock, Yiengst and Watkin, 1953, Shock, Watkin and Yiengst, 1955, Shock, 1954) who have used total body water as an index of functioning protoplasm. Antipyrine and thiocyanate spaces were measured, and metabolic rate was determined by the Tissot open-circuit method. The basal heat production for oxygen consumption per unit of intracellular water, calculated as *antipyrine space minus thiocyanate space*, was *computed and there was* apparently no change with age between 45 and 85 years for Shock concludes: "Thus, if we are willing to accept either total body water or intracellular water as an index of the amount of functioning protoplasm in the intact animal, we are forced to conclude that the oxygen uptake of functioning cells in old individuals is no different from that in young subjects under resting conditions."

Calorie requirements

The following factors are therefore important in considering calorie requirements in the elderly. The metabolic rate of active tissue is probably unchanged, but even if body-weight remains constant there is a decrease in active tissue and a greater volume increase in body-fat, this increase in body-fat is probably mainly the result of appetite not diminishing, or not diminishing sufficiently, whereas activity does diminish and so therefore does the amount of active tissue. Hence, by the criterion of amount of body-fat, old persons are over-eating. The increase in body-fat is probably undesirable.

Scale of calorie allowance—In 1939 Stiebeling and Phipard put forward a scale of calorie allowances and proposed that a reduction of about 10 per cent should be made for persons between the ages of 60 and 75 years, and of about 20 per cent for those over 75 years During the war, the Oxford Nutrition Survey drew up for its own use a table of nutritional allowances (Sinclair, 1948b). These also give decrements in calories, and in vitamins of the B complex, in old age. Calorie allowances were given for males aged 20 to 59 years for six different requirement classes, and for females for five. For those aged 60 years and over a

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early twenties In men the relation between age and basal metabolic expenditure is substantially linear, and at the age of 65 the latter is about 20 per cent less than *at the age of 25 In women the decl*

requirements ... scale which allows for the ... each decac ... cent For ... 7 5 per cent of the requirement ... suggested that requirements be red ... this basis ... groups be

order at the age of 45 may be too large in countries and regions where adults perform throughout middle life the same manual work which they perform in early adult life. In such circumstances, the corrections indicated may still be applied after the age of 45, but it is suggested that up to that age a correction of only 5 per cent per decade may be made. This adjustment is probably desirable only in unusual circumstances because only the factors of manual skill gained from experience and a spontaneous reduction of non-occupational activity will assure a substantial decrease in energy expenditure even though the same manual labour is performed.

It is obvious therefore that the adjustments of the Food and Agriculture Organisation's Committee and of the Oxford Nutrition Survey arose from different considerations. The latter lowered the calorie allowance at 60 years because a man at this age would have less non-occupational activity than a younger man of the same height and weight and occupation, and because the older man would have less active metabolizing tissue and more inactive fat. The Food and Agriculture Organisation's Committee reduced calorie allowances for age much more drastically (at 60 years the allowance is 70 per cent of the allowance at 25 years) because there is a decline in energy expenditure per unit of body size in the basal metabolic state and in the "resting" condition and partly because there is a tendency to reduce activity with increasing age. In this country reasons for elderly men seeking less active jobs have been discussed by Welford (1951) and Richardson (1953).

There is a growing opinion that this age adjustment of the Food and Agriculture Organisation is too large and that 5 per cent per decade would be more suitable. This figure was adopted by the National Research Council (1953). Further, the Fourth Report of the Joint FAO/WHO Expert Committee on Nutrition (1954) stated: "In the United Kingdom, careful attention was given to the appropriateness of the recommendations of the Calorie Committee as applied to the situation in that country. It was concluded that the FAO recommendations underestimated actual needs by some 200 calories per caput daily. More detailed analysis, undertaken partly in consultation with FAO representatives, indicated that the discrepancy arose from the excessive decrement for increasing age beyond 25 years and that a decrement of about 5 per cent for each decade would be more suitable, as far as the United Kingdom is concerned, than the recommended figure of 7.5 per cent." A few studies have been made in the last few years in this country which give some indication of the possible reduction of energy expenditure with increasing age. It is appreciated that the results of various investigations are not comparable since the work is of varying quality and the assessment of calories is made in different ways with different allowances for wastage, different food tables and different conceptions of how to compute the energy value of dietaries. Unfortunately there is not space for a critical appraisal and comparison of the results. An interesting discussion on dietary standards is given by Hobson and Pemberton (1955).

Calorie intake of men

The dietary intake and energy expenditure have been measured for two groups of cadets at Sandhurst (Widdowson, Edholm and McCance, 1954; Edholm and his colleagues, 1955) and for miners and clerks in East Fife (Garry and his

colleagues, 1955) The dietary intake has been measured and energy expenditure estimated for a group of industrial workers in Slough (Bransby, 1954) The dietary intake has been measured for a group of industrial workers on Tyneside (Ministries of Food and Health, unpublished records), for old men in Sheffield (Bransby and Osborne, 1953) and for middle-class men (Widdowson, 1936) Data showing the calorie value of food consumption (food purchases* adjusted for changes in larder stocks) of all *male old-age pensioners living alone* who provided records during 1947-8 in the National Food Survey have been compiled (Ministry of Food, unpublished records) The dietary intake of students under 21 years of age has been estimated by questionnaire (Kitchin and his colleagues, 1949) The results of all these studies are summarized in Table XXVI

Of the 56 men studied in the Ministries of Food and Health Inquiry of 1949, 15 were judged to be doing very light work, 13 light work, 24 moderate work and 4 heavy work, but no significant difference was found in the energy value of the food eaten by the men graded according to activity. Those on heavy work were so small in number that it would probably be fair to assume that the study related to men on very light to moderately active work

Bransby (1954) has recorded that the grades of work of the 146 men whose dietary intakes were measured in 1952 were as follows

Grade of work	*Men of all ages*
Light –	30
Light to medium –	38
Medium to medium heavy	48
Heavy	30

It seems from the results of the East Fife study, that energy expenditure did not vary with age at ages between 20 and 46, for either clerks or miners, though the energy value of food eaten showed a tendency to decrease The numbers of each age group studied were, however, very small In this inquiry the two groups expended the same amount of energy on sleep and out-of-work activities, but the miners, on average, spent nearly 900 calories per man daily more than the clerks at work

The records summarized in Table XXVI suggest that energy intake of men de- creases slightly with age [illegible]

to 2,000 [illegible]

end of l[illegible]

colleagu[illegible]

of [illegible]

[illegible] all records

[illegible] activity but

[illegible] paid employment ceases [illegible]

order at the age of 45 may be too large in countries and regions where adults perform throughout middle life the same manual work which they perform in early adult life In such circumstances, the corrections indicated may still be applied after the age of 45 but it is suggested that up to that age a correction of only 5 per cent per decade may be made This adjustment is probably desirable only in unusual circumstances, ordinarily the factors of manual skill gained from experience and a spontaneous reduction of non occupational activity will assure a substantial decrease in energy expenditure even though the same manual labour is performed

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TABLE XXVII

SUMMARY OF CONCLUSIONS ON ENERGY REQUIREMENTS FOR MEN

Age	*Calorie requirements per head daily*	*As percentage of 20 29*
20–29	3,300	100
30–39	3,250	98
40–49	3,200	97
50–59	3 000	91
60–69	2 500	76
70–79	2 100	64
80 and over	2 100	64

This would suggest a reduction of 1 to 2 per cent per decade between 25 and 45 years of age, a much more rapid rate of reduction between 45 and 65 (6 per cent and 15 per cent respectively for the two decades), and a less rapid rate after 65 (12 per cent between 65 and 75, and thereafter no change)

Calorie intake of women

The data for women are much more sparse than those for men No studies have been made in this country on the energy expenditure of women and no recent records are available on the dietary intake of middle aged women, though the study of Widdowson and McCance (1936) on middle-class women provides some pre war evidence

Students —The women students, all under 21, whose diets were studied in 1947–48 by Kitchin and his colleagues (1949) by questionnaire method were divided into those living at home who took 2,180 calories daily, those in lodgings who took 2,280 and those in hostels 2,330

[illegible]
an [illegible]
in [illegible]
fo [illegible]
2 [illegible] 1,920 The one woman aged 62 took 2,152 calories daily

TABLE XXVIII

SUMMARY OF DATA ON ELDERLY WOMEN STUDIED IN 1947–48 AND 1950–51

Age	*Calorie intake per woman daily*	*Number of individuals*	*Type of individual*	*Reference*
60–69	2 056 (a)	108	Old age pensioners	Ministry of Food
Up to 69	1 902	33	Medically fit	Bransby and Osborne (1953)
70–74	1 483	6		
75 and over	1 740	5		
70–79	1 986 (a)	301	Old age pensioners	Ministry of Food
80–89	1 866 (a)	95		
90–99	1 619 (a)	4		

(a) Purchases adjusted for larder stocks

(Hobson and Pemberton, 1955) that, even in this country where there is little relationship between income and energy value of diet, income plays an important part in determining the dietary intake of the elderly

TABLE XXVI

SUMMARY OF DATA ON ENERGY INTAKE AND EXPENDITURE OF MEN BY AGE

Age	*Calories per man daily*		*Number of individuals*	*Type of individual*	*Date of inquiry*	*Reference*
	Intake	*Expenditure*				
18½–20	3,705	3 420	77	Cadets	1952	Widdowson *et al* (1954)
18½ 20	3 432	3 416	12	Cadets	1953	Edholm *et al* (1955
18 & 19	3 400	—	5	Middle class	1936	Widdowson (1936)
Under 21				Undergraduates		
	3 040 (a)	—	61	At home	1947–48	Kitchin *et al* (1949)
	2 900 (a)	—	47	In lodgings		
	2 960	—	19	In hostels		
20 29	3 457	—	16	Industrial workers	1949	Ministries of Food and Health
	3 593	—	44	Industrial workers	1952	Bransby (1954)
	3 080	2 830	7	Clerks	1952	Garry *et al* (1955)
	4 320	3 500	4	Miners		
	3 250	—	29	Middle class	1936	Widdowson (1936)
30–39	3,568	—	16	Industrial workers	1949	Ministries of Food and Health
	3 510	—	50	Industrial workers	1952	Bransby (1954)
	2 770	2 700	2	Clerks	1952	Garry *et al* (1955)
	4 090	3 710	8	Miners		
	2 920	—	10	Middle class	1936	Widdowson (1936)
40–49	3 241	—	12	Industrial workers	1949	Ministries of Food and Health
	3 432 (b)	—	52	Industrial workers	1952	Bransby (1954)
	3 360	2 800	1	Clerks	1952	Garry *et al* (1955)
	3 790	3 690	7	Miners		
	2 990	—	9	Middle class	1936	Widdowson (1936)
50–59	2 890	—	5	Middle class	1936	Widdowson (1936)
	3 295	—	8	Industrial workers	1949	Ministries of Food and Health
60–69	2 916	—	4	Industrial workers		
	2 270	—	3	Middle class	1936	Widdowson (1936)
65–69	2 261	—	9	Medically fit	1950 51	Bransby & Osborne (1953)
	2 341 (c)	—	19	Old age pensioners	1947–48	Ministry of Food
70–74	2 254	—	17	Medically fit	1950 51	Bransby & Osborne (1953)
75 & over	2 015	—	7			
70–79	2 110	—	76	Old age pensioners	1947–48	Ministry of Food
80–89	2 148	—	21			

(a) By questionnaire
(b) For age group 40 and over
(c) Purchases adjusted for larder stocks

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Middle-class women.—The pre war middle-class women studied by Widdowson and McCance took on average 2,187 calories daily There was a decrease of energy intake with [illegible] n of 19 took 2,634, the average [illegible]–39, 2,180, for the 4 aged 40–49, [illegible] one woman aged 62 took 2,152 calories daily

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TABLE XXVI

SUMMARY OF DATA ON ENERGY INTAKE AND EXPENDITURE OF MEN BY AGE

Age	*Calories per man daily*		*Number of individuals*	*Type of individual*	*Date of inquiry*	*Reference*
	Intake	*Expenditure*				
18½–20	3 705	3,420	77	Cadets	1952	Widdowson *et al* (1954)
18½–20	3 432	3 416	12	Cadets	1953	Edholm *et al* (1955)
18 & 19	3 400	—	5	Middle class	1936	Widdowson (1936)
				Undergraduates	1947–48	Kitchin *et al* (1949)
Under 21	3 040 (a)	—	61	At home		
	2 900 (a)	—	47	In lodgings		
	2 960	—	19	In hostels		
20–29	3 457	—	16	Industrial workers	1949	Ministries of Food and Health
	3 593	—	44	Industrial workers	1952	Bransby (1954)
	3 080	2 830	7	Clerks	1952	Garry *et al* (1955)
	4 320	3 500	4	Miners		
	3 250	—	29	Middle class	1936	Widdowson (1936)
30–39	3 568	—	16	Industrial workers	1949	Ministries of Food and Health
	3 510	—	50	Industrial workers	1952	Bransby (1954)
	2 770	2 700	2	Clerks	1952	Garry *et al* (1955)
	4 090	3 710	8	Miners		
	2 920	—	10	Middle class	1936	Widdowson (1936)
40–49	3 241	—	12	Industrial workers	1949	Ministries of Food and Health
	3 432 (b)	—	52	Industrial workers	1952	Bransby (1954)
	3 360	2 800	1	Clerks	1952	Garry *et al* (1955)
	3 790	3 690	7	Miners		
	2 990	—	9	Middle class	1936	Widdowson (1936)
50–59	2 890	—	5	Middle class	1936	Widdowson (1936)
	3 295	—	8	Industrial workers	1949	Ministries of Food and Health
60–69	2 916	—	4	Industrial workers		
	2 270	—	3	Middle class	1936	Widdowson (1936)
65–69	2 261	—	9	Medically fit	1950–51	Bransby & Osborne (1953)
	2 341 (c)	—	19	Old age pensioners	1947–48	Ministry of Food
70–74	2 254	—	17	Medically fit	1950–51	Bransby & Osborne (1953)
75 & over	2 015	—	7			
70–79	2 110	—	76	Old age pensioners	1947–48	Ministry of Food
80–89	2 148	—	21			

(a) By questionnaire
(b) For age group 40 and over
(c) Purchases adjusted for larder stocks

income was stated to be above £3 bought slightly more calories per day than those on smaller incomes If the three upper income groups are excluded the calorie values of food purchased in the various age groups are as follows

Age		*Calorie value of food purchases*
55–59	– –	2990
60–64	– –	2860
65–69	– –	2670
70–74	– –	2580
75–79	– –	2590
80 and over	– –	2460
Average	– –	2660

Change in energy expenditure —The lack of data on the actual dietary intake of middle-aged women in this country makes it difficult to judge how great a change in energy expenditure occurs between youth and middle age The results of Widdowson and McCance (1936) suggest a reduction of about 100 calories from 2,300 at 20–29 per decade to 1950 at 50–62, but pre-war middle class women may have led less energetic lives than their counterparts today, this might be particularly important for the women today of 30 to 45 who have the care of a home and young children, on whom no studies have been made It seems from the data in Table XXVIII that women of over 60 consume less than 2,000 calories daily but not less than 1,500

Protein

Loss of body protein

We have seen that active tissue, mainly muscle, tends to decrease in the elderly and fat to increase This change *represents* a loss of body [illegible]

[illegible] decreased appetite and defective teeth, tend to partake of a diet high in carbohydrate and low in protective foods including those rich in protein It might *represent* failure to digest or absorb protein, or *failure* to metabolize its products in the liver or other tissues.

Dietary deficiency —Dietary deficiency of calories might be a cause of protein deficiency, particularly since diets low in calories *tend to* be low in protein Ohlson and her colleagues have studied [illegible]

Elderly women.—The dietary records of 508 female old age pensioners living alone and supplying data on food purchases and changes in larder stocks for the National Food Survey in 1947–48 have been examined. No records of food wastage are available, but as the data were obtained at a time of national food stringency, wastage was probably small. In 1950–51, the dietary intake of 44 elderly women, graded as medically fit, was measured by Bransby and Osborne (1953); the diets were discussed in relation to income by Hobson and Pemberton (1955). The results of these two studies are summarized in Table XXVIII.

In comparison, Pyke and his colleagues (1947) found that 28 women aged between 50 and 85 years living at home or in almshouses recorded in daily diaries quantities of food equivalent to between 1,034 and 2,313 calories daily, with averages of about 1,400.

The food purchases, with no adjustments for changes in larder stocks or for wastage, of 722 women of 55 years of age and over who were living alone and who provided records for the National Food Survey in 1953–54 have been analysed (Baines and Hollingsworth, 1955). Table XXIX shows the average daily calorie values of food purchases per diet head (adjusted to allow for meals taken away from home or for visitors to their home) analysed according to age and income. For each group the number of individuals concerned is given in brackets.

TABLE XXIX

CALORIE VALUES OF FOOD PURCHASES OF ELDERLY WOMEN

Stated income per week	*Age group* 55–59	60–64	65–69	70–74	75–79	*80 and over*	*All*
£	-		2 850(8)	2 620(9)	2 650(3)	1 900(1)	2,790(57)
£			2 970(21)	2,640(8)	2 190(3)	2 460(3)	2 990(69)
£			3 060(22)	2 670(20)	2 680(8)	2,320(5)	2 870(106)
£			2,690(21)	2 660(22)	2,500(24)	2 550(9)	2 650(100)
£			2 670(26)	2 710(40)	2 770(20)	2,600(7)	2 690(121)
£			2,530(25)	2 590(24)	2 510(24)	2 710(12)	2,670(111)
£			2,760(36)	2 280(25)	2,600(26)	2,090(13)	2 630(123)
N			3,550(8)	2,420(4)	2,540(6)	2 220(5)	2 670(35)
Average	2 970(80)	2 910(153)	2 820(167)	2,580(152)	2,580(114)	2,400(56)	2,740(722)

The number of individuals for each age group is given in brackets

Household wastage.—No data are available on household wastage and all recent National Food Survey records for households containing only adults suggest considerable wastage in the home. For example, the daily calorie value of food purchases in three types of adult household in 1954 were 2,952 (1 man and 1 woman, one or both over 55), 3,174 (1 man and 1 woman, both under 55) and 2,770 (other adult groups) (H.M.S.O., 1954).

Purchase figures and calorie intake.—The relationship between these purchase figures and actual intake cannot be guessed. Two points are, however, of interest in the present context. The first is that taking all income groups together the calorie value of food purchases of elderly women did not increase appreciably with age until after 70. The second point is that, taking all age groups together, those whose

testicular extracts for rejuvenation It is fashionable now to include the adrenal cortex "The general asthenia, disturbed gastro intestinal function, tendency to increased pigmentation and low basal metabolic rate are symptoms common to both adreno-cortical insufficiency and old age" (Hall, 1948) But adreno-cortical function after administration of ACTH is apparently normal in old men (Duncan and his colleagues, 1952) We need more knowledge upon this topic

Fat

Increase of body fat and body weight increase

We have seen that body fat increases during the period of maturity, the figures in Table XXXI are for men and are taken from Brožek (1952) Thus for men total body weight increases during this period since body fat increases, and "active tissue' decreases if we assume that bone remains unchanged Two recent studies

TABLE XXX

AVERAGE ESTIMATED CHANGES IN BODY COMPOSITION DURING MATURITY (20–55 YEARS) STANDARD WEIGHTS REFER TO MEN 176 CENTIMETRES TALL

Age	*Standard Weight* kg	*Standard Fat* %	*Fat* kg	*Fat free Weight* kg
20	67 6	10 30	6 96	60 6
25	69 9	13 42	9 38	60 5
30	71 3	16 20	11 55	59 8
35	72 9	18 64	13 59	59 3
40	74 1	20 74	15 37	58 7
45	75 5	22 50	16 99	58 5
50	76 0	23 92	18 18	57 8
55	76 8	25 01	19 20	57 6

of male body weights in this country have, however, given no evidence of increasing weight in industrial employment after the age of 30 to 35 years The Ministry of Food s wartime body weight survey (Kemsley, 1950) showed no evidence of increasing weight with age after about 35 years in 27,500 men working in mines and factories The second study made between 1945 and 1954 on nearly 1,700 men in two factories in Birmingham gave a similar result (Lowe and Gibson, 1955) In studying these figures, however it should be bo [illegible]

Absorption of fat by intestines

It has been sugg[illegible] the intestine in [illegible] creatic lipase ([illegible] demonst[illegible]

A later study indicated that after the age of 70 years four women could maintain bodily reserves on about 1,500 calories daily (Ohlson and her colleagues, 1950) Addition of milk to the diet of women over 60 years caused retention of nitrogen which was interpreted as indicating previous depletion of protein although each subject apparently had been in equilibrium at the lowered nutritional plane (Ohlson and her colleagues, 1952) In the most extensive study the estimates of dietary protein required for equilibrium were 66 grammes at 30 to 39 years, 69 grammes at 40 to 49 years, 70 grammes at 50 to 59 years 67 grammes at 60 to 69 years, and 59 grammes after 70 years (Ohlson and her colleagues, 1952) It appeared that the protein requirement of women remained high until the age of 70 years Stresses such as worry or respiratory illnesses, and alteration of the customary dietary habits such as partaking of a small breakfast, apparently increase protein requirements (Leverton and Gram, 1949, Tuttle, Wilson and Daum, 1949)

Serum protein

Serum protein does not necessarily bear any relation to dietary protein and severe deficiency of protein can exist with normal levels of serum protein The following quotation from a chapter on "Nutrition problems of geriatric medicine" (Stieglitz, 1951) shows what grossly erroneous conclusions can be reached

> It is not difficult to determine the degree of protein deficiency of the serum protein concentration Normally, the serum protein should be about 7 grammes per 100 millilitres To illustrate the calculation necessary to determine the total protein deficiency we may take as an example an instance wherein the serum protein is 5 grammes per 100 millilitres This represents a deficit of 2 grammes per 100 millilitres of serum The plasma volume is 5 per cent of the total body weight Thus, if the patient weighs 70 kilograms (154 pounds), we know that the plasma weighs 3 5 kilograms or is approximately 3,500 millilitres in volume Therefore, a deficiency of 2 grammes per 100 millilitres multiplied by 35 equals a total deficit of 70 grammes in plasma protein For each gramme of plasma protein reduced from the normal it is estimated that there exists a 30-gramme depletion of the tissue protein reserves Therefore, 70 times 30 equals 2,100 grammes as the depletion of tissue protein Thus, the total protein deficiency is 2,170 grammes If the deficit is to be restored, it is necessary that a total ingestion of something over 2,000 grammes of protein be added to the usual daily requirement of 1 gramme per kilogram per day

Nitrogen balance

Digestion and absorption have already been discussed there is no evidence of impaired protein nutrition in the elderly from imperfections of these For instance in nitrogen balance studies on old men, Bogdonoff, Shock and Nichols (1953) found that nitrogen in the faeces was not increased above that found usually in younger adults High faecal nitrogen was, however, found in 3 old men (Daum and his colleagues, 1952) Similarly, there is no evidence that impairment of liver function in old age causes faulty metabolism of protein

Endocrine glands

Protein anabolism is profoundly affected by the endocrine glands, and a long line of gerontologists from Brown Sequard to Korenchevsky have championed

cholesterol occurs by the liver converting it into cholic acid which is then excreted in bile into the small intestine

Hypercholesterolaemia and atherosclerosis.—It is generally agreed that there is a relation between hypercholesterolaemia and atherosclerosis. First, a large amount of free and esterified cholesterol is found in the atheromatous plaque, the ratio of one to the other being however the same as in normal plasma. This naturally suggests that the cholesterol comes from plasma and this has been proved for at least some of it by labelling ingested cholesterol and finding some of this in the atherosclerotic aorta (Biggs and his colleagues 1952). Secondly, increased atherosclerosis occurs in clinical hypercholesterolaemia whether familial idiopathic or accompanying nephrosis, diabetes mellitus, xanthomatosis or hypothyroidism. Thirdly [illegible]

[illegible] the elevation of plasma cholesterol in certain lower animals may produce atherosclerosis. For the present purposes we shall accept that raised plasma cholesterol tends to be associated with atherosclerosis, but we cannot discuss in this connexion the relevance of chylomicra, lipoproteins or phospholipids nor the effect of diet upon these (Keys and his colleagues 1955). We are concerned with the origin of the rise in plasma cholesterol with age though it may well be that we should direct our attention most to the cholesterol in the β lipoprotein fraction in which are included Gofman's giant molecules and [illegible]

[illegible] these are not extreme but does vary with dietary fat. There have been suggestions to this effect [illegible]

[illegible]

[illegible] cholesterol and concluded that even [illegible] variations in intake of fat on a normal diet might be sufficient to alter the serum-cholesterol level

The most extensive work upon this subject has been done by Keys who has studied the relation between dietary fat and plasma cholesterol in a variety of countries including this country when we were fortunate to [illegible] our laboratory [illegible]

[illegible] heart disease is borne out by

counts were correlated with inactivity and not with age (White, Ralston and Carne, 1951).

Sex hormones

As in the consideration of protein metabolism, we must mention sex hormones This matter has been partially investigated by Deuel who found indirect evidence from work on rats (Butts and Deuel, 1933, Deuel, Hallman and Murray, 1937, Deuel, 1954) to support the view that the higher fasting ketonuria of the female as compared with the male (Deuel and Gulick, 1932) largely disappeared after the menopause

Ingestion of fat and atherosclerosis and coronary thrombosis

The aspect of fat metabolism in the elderly that is receiving greatest current attention is the relation of ingestion of fat to atherosclerosis and coronary thrombosis This very large subject cannot be reviewed here in detail nor can the evidence for and against the various claims be presented A brief and dogmatic account will therefore be given We start with the relevant facts about the metabolism of cholesterol, the plasma concentration of which increases with age (Keys and his colleagues, 1950, Keys, 1952, Keys and his colleagues, 1952, Hobson, Jordan and Roseman, 1953), despite claims on inadequate evidence that this does not customarily occur (Page and his colleagues, 1935, Sperry and Webb, 1950) Keys' data show a fairly steady rise from the age of 20 to about 55 years and then a fall, the increase between the ages of 17 and 45 years being 2 29 milligrams of total cholesterol per 100 millilitres of serum yearly. Hobson and his colleagues (1953) found that the levels tended to fall after 70 years, which would be expected if higher serum-cholesterol levels are associated with lessened expectation of life

Cholesterol

Cholesterol, most of which is free in the diet, is absorbed in the distal half of the small intestine with the aid of bile acid, fat assists the absorption partly by acting as an emulsifying agent and partly by providing fatty acids for esterification This occurs either in the lumen of the gut being brought about by an enzyme from the pancreas, or esterification occurs in the intestinal mucosa Cholesterol is therefore present in the lymphatics mainly esterified, and most is found in the chylomicron fraction Decreased intestinal absorption of cholesterol is thought to occur on low-fat diets and after ingestion of dihydrocholesterol or possibly sitosterol The chylomicra are cleared from blood partly by the heparin clearing-reaction and partly by their removal by reticulo-endothelial cells mainly of the liver Cholesterol is stored in the hepatic parenchymal cells The liver is not only a store of dietary cholesterol but is the most active organ in the synthesis of cholesterol from acetate, this synthesis can also be done by most organs except adipose tissue and mature cerebral tissue Liver-made cholesterol is discharged into plasma and bile in the free state The synthesis in the liver is decreased by the following (1) Increasing age (at least in rats), (2) increased dietary cholesterol, (3) hypothyroidism, and (4) administration of oestrogens Synthesis is increased by thyroid hormone but this does not increase blood cholesterol Destruction of

holesterol occurs by the liver converting it into cholic acid which is then excreted n bile into the small intestine.

Hypercholesterolaemia and atherosclerosis.—It is generally agreed that there is a relation between hypercholesterolaemia and atherosclerosis. First, a large amount of free and esterified cholesterol is found in the atheromatous plaque, the ratio of one to the other being however the same as in normal plasma. This naturally suggests that the cholesterol comes from plasma and this has been proved for at least some of it by labelling ingested cholesterol and finding some of this in the atherosclerotic aorta (Biggs and his colleagues, 1952). Secondly, increased atherosclerosis occurs in clinical hypercholesterolaemia whether familial idiopathic or accompanying nephrosis, diabetes mellitus, xanthomatosis or hypothyroidism Thirdly, there ...

Fourthly, the elevation of plasma cholesterol in certain lower animals may produce atherosclerosis For the present purposes we shall accept that raised plasma cholesterol tends to be associated with atherosclerosis, but we cannot discuss in this connexion the relevance of chylomicra, lipoproteins or phospholipids, nor the effect of diet upon these (Keys and his colleagues, 1955) We are concerned with the origin of the rise in plasma cholesterol with age, though it may well be that we should direct our attention most to the cholesterol in the β-lipoprotein fraction in which are included Gofman's "giant molecules" and which contains most of the cholesterol

Plasma cholesterol.—In general, plasma cholesterol does not vary with alterations in dietary cholesterol provided these are not extreme but does vary with dietary fat There have been suggestions to this effect for many years ...

... atherosclerosis ...

... and Jerome (1955) ... serum cholesterol in old persons of both sexes to be positively correlated with both chole...

The most extensive work upon this subject has been done by Keys who has studied the relation between dietary fat and *plasma cholesterol* in a variety of countries including this country when we were fortunate to have him with us in our laboratory Keys maintains "Both controlled experiments ... of populations ...

... heart disease is borne out by

data from various countries" (Keys and Anderson, 1955, earlier references to Key's papers are given herein) It is possible that Keys has somewhat over-simplified the relation between diet and plasma cholesterol Groen, as a result of experimental work on man, has concluded "If a high blood cholesterol should have such an atherosclerosis-promoting effect, it might be necessary to take into account as factors producing hypercholesterolaemia not only diet and individual characteristics, but also the after-effects of infections, physical exertion and emotions as possible factors of aetiological significance Finally, by demonstrating the influence of both nutrition and stress on the serum cholesterol our *observations might* bridge the gap between those authors, who have regarded atherosclerosis as of nutritional origin only and those who have pointed out its frequent occurrence among patients who have laboured under strain" (Groen and his colleagues, 1952)

Further, as Keys admits, "The effects of different food fats in man have been inadequately studied" (Keys and Anderson, 1955) Kinsell has studied vegetable fats and has concluded that his findings "demonstrate beyond any reasonable doubt that fat *per se* does *not* result in increased serum cholesterol levels" He finds that feeding large amounts of vegetable fat to diabetics with or without hypercholesterolaemia consistently lowers plasma cholesterol whereas there is a prompt rise when isocaloric amounts of animal fat are substituted (Kinsell and his colleagues, 1954) Kinsell suggests that possibly a phosphatide present in vegetable fat may lower plasma cholesterol

It is known that chylomicra will reduce the clotting time of centrifuged plasma in presence of Russell's viper venom (Macfarlane, Trevan and Attwood, 1941), and only recently the coagulant effect of chylomicra has been shown to be probably caused by the presence in them of ethanolamine phosphatide (Poole and Robinson, 1956, Robinson and Poole, 1956) It is important to distinguish clearly between atherosclerosis and coronary thrombosis There is little doubt that coronary thrombosis seldom occurs without advanced coronary atheroma, but that atheroma very commonly occurs without coronary thrombosis There may therefore be two entirely distinct factors in the aetiology of coronary thrombosis, a factor causing atherosclerosis and a factor causing clotting on the atheromatous plaque Morris (1951) has produced some very interesting information upon this which indicates that in this country from before World War I the incidence and degree of coronary atheroma have not increased and may have decreased but the incidence of coronary thrombosis has greatly increased In 1954 I tentatively suggested at the British Association that this might be explained by supposing that the level of total dietary fat was related to the incidence of atheroma (both have remained reasonably *constant over this period*) but that the level of dietary *vegetable* fat might be related to the incidence of clotting upon the atheromatous plaques, there is a good positive correlation in this country between dietary vegetable fat and deaths from coronary thrombosis (Sinclair, 1955b) Macfarlane (1955) put forward the same hypothesis Put crudely, a dietary high in total fat or in which a large proportion of the calories comes from fat is associated with atheroma, but for production of coronary thrombosis *atheroma must normally be present in addition to that factor* which increases the coagulability of blood and which is present in processed vegetable fat Of course such correlations prove nothing there is probably an excellent correlation over this period between deaths from coronary thrombosis

and the number of aeroplanes flying overhead. Also, coronary thrombosis is increasing rapidly in some countries (New Zealand and to a less extent Australia)

and palm oils, can under certain conditions be toxic (Kesten, Salcedo and Stetten, 1945, Wilgram, Harrtoft and Best, 1954), these oils are common constituents of margarine in Europe.

Our own experimental work together with a careful assessment of the literature has, however, given us what we believe may be the solution of the problem The diets of civilized countries are in general becoming richer in fats, and especially in the more saturated fats, at the expense of the essential unsaturated fatty acids (EFA), our diets also contain increasing quantities of unnatural fats. These disastrous alterations bring about a chronic relative deficiency of the essential fatty acids, linoleic and arachidonic, the former can be converted in the body to the latter in presence of vitamin B_6 (pyridoxine) Bread of low extraction, "improved" with powerful oxidizing agents such as agene or chlorine dioxide,

genation, part of the EFA is destroyed and some unnatural *trans* fatty acids are formed Because of this

occur in the

than usual,

contain fatt ... saturated than usual, or unnatural fatty acids The abnormal cholesterol esters are less readily disposed of, become deposited and so form atheroma Similarly, abnormal phospholipids (such as an abnormal phosphatidyl ethanolamine) are less readily disposed of, remain in plasma and increase the coagulability of blood thereby contributing to coronary and cerebral thrombosis We believe abnormal or defective phospholipids, produced through deficiency of EFA, cause changes in the structure of

contribut

increase

x-irradia ... thereby contributing to leukaemia and to carcinoma of the lung and stomach Further abnormal

phosphol

demye

in cert ... system Since the requirement of male lower animals for EFA is some five to ten times that of females, deficiency would be expected to manifest itself

this *thesis* is that

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hypothesis Put crudely, a dietary high in total fat or in which a large proportion of the calories comes from fat is associated with atheroma, but for production of coronary thrombosis atheroma must normally be present in addition to that factor which increases the coagulability of blood and which is present in processed vegetable fat Of course such correlations prove nothing, there is probably an excellent correlation over this period between deaths from coronary thrombosis

(1948, 1952) and Roberts and his colleagues (1948) found intakes for old women of the order of 0 7 gramme but as a result of their studies, "at least 1 gramme of calcium per day is suggested as desirable for healthy older women", they computed that the requirements for each decade from 30–39 years to 70–79 years were 0 88, 0 87, 0 83, 0 92 and 0 73 gramme daily A progressive demineralization of the skeleton is a characteristic feature of ageing (Todd, 1942) and the subject has been reviewed by Cobb (1952) The skeleton appears in general to increase in weight to about the age of 35 years, then to decrease gradually until about 65 years, and then to decrease progressively during old age This demineralization is influenced by the general atrophy in ageing (Vinther Paulsen, 1953), and the failure of the normal anabolism of protein that forms bone matrix and which is affected by endocrine secretions undoubtedly plays a prominent part Considerable research has been done by Nicolaysen and his colleagues (Nicolaysen and Eeg-Larsen, 1953 Nicolaysen Eeg Larsen and Malm, 1953, Malm, Nicolaysen and Skjelkvale, 1955) but when he was asked by Professor Brull at the Ciba Symposium whether he thought senile osteoporosis with collapse of the vertebrae was caused by lack of [illegible]

[illegible] and the incidence of osteoporosis, serum calcium or excessive extra-skeletal calcification

Vitamins

Normal blood values for pyruvic acid, thiamine, ascorbic acid, carotenoids and vitamin A are discussed elsewhere (*see* Chapter 3) In a series of papers Rafsky (1954) has attempted to study normal ambulatory individuals aged between 65 and 89 years in an institution in New York The main results appear to have been that serum vitamin A and carotene levels were in general low but no defect in absorption could be demonstrated Thirty five elderly persons whose age range was between 65 and 90 years (of whom 19 were males, 15 females and therefore one presumably of unknown sex) complained of fatigue and [illegible]

[illegible] elderly to relieve idiopathic [illegible] the commonest causes of which however, are diminished cardiac output and the physiological accompaniments of mental enfeeblement

In lower animals the requirement of thiamine is apparently greatly increased in old age but in man no convincing evidence has been produced for increased needs of vitamins with one exception that of vitamin B_{12}

Vitamin B_{12}

Chow (1954) has studied the absorption of vitamin B_{12} from the intestine of the young and old using a new form of oral tolerance test, a large amount (250 or 1 000 micrograms) of vitamin B_{12} is given by mouth to the subjects, and blood samples are taken just before and 1½ and 3 hours after administration and the sera

ages ranged from 50 to 89 years In the summer and autumn of 1952 the group were examined again (Chope, 1954) Surprisingly it was found that there was a lower incidence of circulatory diseases among the individuals with a higher caloric *intake though figures in support of this claim* are not given in the report and it cannot be assessed whether the individuals with higher caloric intake were obese There was a high incidence of non-fatal circulatory diseases in those who had high levels of serum cholesterol but the individuals with high dietary cholesterol had fewer circulatory diseases than the average for the entire group This longitudinal study is of great importance and full details of the results may cause us to revise some of our views about nutrition in the elderly*

Calcium

The bones of old people break easily This fact has been known for centuries, but we still know little about the origin of senile osteoporosis Sherman (1920), as *a result of metabolism studies on 24 subjects, mostly women, put the adult* requirement at 0 45 gramme daily for maintenance in a 70-kilogram man Leitch (1937) concluded that 0 45 gramme daily, which was the estimated average calcium intake of Orr's Groups 1 and 2 in this country, might produce osteoporosis of the degree giving "rheumatic" pains in 10 to 13 years However, Albright and Reifenstein (1948) "do not believe that calcium lack *per se* causes osteoporosis", they consider that" some of the osteopathies which have been attributed to lack of calcium and phosphorous in the diet are really due to protein starvation" Snapper (1950) thought that primary calcium deficiency was extremely rare and that osteomalacia responded to vitamin D but not to calcium Hegsted and his colleagues found in the literature "no solid evidence that calcium deficiency occurs in adult males" and concluded from their results on prisoners that the "minimum calcium requirement of adult males is probably so low that deficiency is unlikely on most natural diets" They concluded that the average requirement to [illegible] years was between [illegible] *lculation (Hegsted,* [illegible] d calcium requirements in old age and McCay (1949) added further data He found differences in absorption and in selection of diets between young and old rats, the latter failing to choose diets rich in calcium *"Thus in old age when the body s need for calcium* in the diet increases, the ability to select this diet seems to disappear"

Dietary allowance

The daily dietary allowance was put at 0 8 gramme by the British Medical Association's Committee (1950) which was about the same as the figure (0 75 gramme) adopted during the war by the Oxford Nutrition Survey (Sinclair, 1948b) the National Research Council (1953) reduced to 0 8 gramme the figure of 1 0 gramme it had recommended in 1948 This figure of 0 8 gramme is slightly higher than that estimated to have been met with in studies of the dietary intakes of old persons Thus Pyke and his colleagues (1947) found a mean value of about 0 6 gramme for old women and 0 9 gramme for old men, Ohlson and her colleagues

* Since writing this chapter full details of this study have been published by Agnes Morgan and her colleagues (Morgan 1955)

TABLE XXXI

ALLOWANCES FOR PERSONS AGED 60 AND OVER

	Daily allowance		Therapy p o daily	Good food sources
	Men	Women		
Calories				Milk, national bread
Basal	1500	1250	—	
Sedentary	2000	1750	—	
Light work	2500	2000	—	
Medium work	2750	2250	—	
Protein (grammes)	72	60	—	Milk, cheese, meat, national bread
Fat (grammes)	90	70	—	Butter, milk
Iron (milligrams)	10	10	Ferrous sulphate 200–300	Liver, lean meat, raisins, apricots
Calcium (grammes)	0 75	0 75	Calcium lactate 1–4	Milk, cheese, cabbage, bread
Phosphorus (grammes)	1 0	1 0	Calcium phosphate 0 6–2	Milk, cheese, meat
Vitamin A (international units)	2500	2500	Liq Vitamin A Conc 2 500–25 000 (0 06–0 6 ml)	Liver, fatty fish, spinach, carrots, cabbage
Vitamin D (international units)	200	200	Liq Vitamin D Conc. 5 000–50 000 (0 5–5ml)	Fatty fish, liver, egg-yolk
Thiamine (milligrams)	1 0	0 8	20–50	Liver, pork, national bread, beans
Nicotinic acid (milligrams)	10	8	50–250	Liver, meat national bread fish
Riboflavin (milligrams)	1 5	1 2	5–10	Milk, liver, meat, eggs, cabbage
Pyridoxin (milligrams)	? 1 5	? 1 5	20	Liver, national bread, meat
Folic acid (milligrams)	? 0 2	? 0 2	5–20	Meat, eggs, fish, liver, cabbage
Vitamin B_{12} (micrograms)	? 1 0	? 1 0	50–100 intramuscularly (weekly or less frequently)	Liver meat, fish, milk
Ascorbic acid (milligrams)	30	25	200–500	Citrus fruit, cabbage, tomatoes, potatoes
Choline (milligrams)	? 300	? 300	2,000	Egg yolk, brain, national bread

start if, as is very often the case, the kidney is unable to excrete more water for then circulatory overloading and heart failure or sudden death may occur

Over-nourishment

The very causes of under nourishment may in other cases be those of obesity since boredom or inability to provide satisfying diets may lead to excessive con- [illegible] of atherosclerosis the aetiology

analysed for the vitamin The maximum rise occurs in two to three hours, and the magnitude is taken as a measure of the ability of the individual to absorb the vitamin, response is considered positive if the rise in serum level is 150 micrograms or more The response was significantly less in old persons This may be caused by the lower binding power of the gastric secretion in the elderly, and may be responsible for the lower serum level of vitamin B_{12} which has been found by others in the elderly (Mollin and Ross, 1952) Parenteral administration was followed by less vitamin B_{12} in the urine of the elderly, and this greater retention in them is probably an indication of greater tissue desaturation following decreased intestinal absorption which is itself caused by decreased binding power of the gastric secretion of the elderly Whether these are actual signs of deficiency has not been investigated

Nutritional requirements

We may conclude this section and introduce the next by summarizing the approximate nutritional requirements for old persons of average size (Table XXXI) Therapeutic amounts are also given for oral administration which is of course best in divided doses The food sources are not necessarily the richest, and "cabbage" can be substituted by other green leafy vegetables The great importance of milk and national bread, with some source of ascorbic acid, cannot be too strongly stressed

DIAGNOSIS AND THERAPY

Under-nourishment

Anorexia is frequent in the elderly for reasons that have already been mentioned Old persons, whether living alone or in an institution, may be anxious, bored, listless and depressed through feeling unwanted They may be unable to purchase and prepare food, and they may have difficulty in eating it Under-nourishment is therefore apt to arise and may produce the emaciation syndrome which, in its advanced stages, resembles anorexia nervosa The patients lie immobile, listless and apathetic Muscles have atrophied, body-fat has been burnt, the skin is pale, cold and wrinkled, the pulse is slow and the blood pressure low, the eye is sunken and dull Nutritional oedema is commoner in the elderly than at any other age, and it tends to occur in marked but not extreme under-nourishment when the intake of salt is fairly high It is not usually caused by lowered colloidal osmotic pressure of serum or by laxity of the tissues and it may be caused by increased secretion of aldosterone from the adrenal cortex causing increased retention of salt and water Of course hypoproteinaemia may cause generalized oedema and oedema of the legs is not uncommonly caused by immobility such as may be associated with arthritis of the knees or hips

The diagnosis of under-nourishment is usually easy particularly if there is reason for anorexia or if the patient is partaking of a restricted monotonous diet for ulcer or hypertension But if it is caused by unexplained anorexia or indigestion, a careful clinical examination is required because of the possibility of organic and particularly malignant disease After thorough investigation, the re-feeding must be cautious and not more than 1,500 millilitres of fluid should be given daily at the

heralded by symptoms of vague ill health such as fatigue lassitude weakness and anorexia Senile psychosis may be simulated by Wernicke s encephalopathy, caused by deficiency of thiamine or by the encephalopathy of deficiency of nico

consumes largely bread and jam or processed foods The recognition is complicated by the great ease with which spontaneous bruising occurs particularly in old women perhaps because subcutaneous elastic tissue is lacking An important diagnostic point here is that the petechiae of scurvy are perifollicular I have seen vagabond s disease diagnosed as scurvy but bugs do not limit themselves to the hair follicles I have also seen the diagnosis of scurvy dismissed because there were no bleeding gums but scorbutic gums of the edentulous do not bleed Scurvy is often missed in the elderly for another reason it may be diagnosed as arthritis when in fact there is a haemarthrosis associated with a relatively trivial injury

According to Willis and Fishman (1955) gross deficiency of ascorbic acid is often found in the arteries of apparently well nourished hospital patients at autopsy and the deficiency appears to be accentuated by old age the depletion is probably not nutritional but rather related to the stress of the fatal illness They believe that a localized depletion often exists in segments of arteries susceptible to arteriosclerosis for reasons of mechanical stress, and adjacent segments where mechanical stress is less tend to have more ascorbic acid and no atherosclerosis In scurvy in guinea pigs depletion of ascorbic acid results in rapid onset of atherosclerosis and they state synthesis of cholesterol in tissues is several times more rapid when they are depleted of ascorbic acid They advocate therapy with ascorbic acid to replenish that in the arteries but their conclusions cannot be considered to be more than tentative

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we ... for six weeks and 20 were given placebos The patients ages ranged from 58 to 89 years 34 of those receiving vitamins were claimed to be improved in general health and in spirit psychological tests were included The improvement stopped when additional vitamins were withdrawn The authors believe that old people have vitamin requirements higher than normal

Hypervitaminosis

Enormous amounts of vitamins are adm ...
purposes and enorm ...
vitaminosis
times used ...
alkalosis ... effects are aided by
intestinal ... patients with gastro- ... are more susceptible to the toxic effects (Reed and his colleagues 1937) Early symptoms are anorexia nausea (perhaps with vomiting) headache weakness lassitude polyuria, diarrhoea and epigastric pain Plasma calcium is raised and metastatic calcification occurs in arteries joints kidneys myocardium and other soft tissues Evidence of renal insufficiency may be found with hypertension and retinopathy

change the food habits of the elderly since these have been acquired through a lifetime In any case, reduction in weight should be gradual, of the order of 1 pound weekly. It is easier to achieve in an institution by group therapy than in individuals living alone Vitamin and protein intakes should be maintained, fat in particular being reduced The administration of thyroid hormone must be avoided entirely unless definite evidence of deficiency of it is apparent.

Protein deficiency

Under-nourishment is to some extent accompanied by deficiency of protein since body-protein will be burnt Nothing is known of amino-acid requirements in old age or particular deficiencies of these but deficiency of protein may arise following damage to the liver or kidney Mild deficiency of protein may be found in some anaemias The subject of protein is, of course, discussed fully on page 317

Calcium deficiency

The possible roles of deficiency of protein and of calcium in senile osteoporosis have already been mentioned We know insufficient at present about the process *leading to this which may cause "rheumatic" pains and considerable disability* and discomfort In advanced cases the bones become demineralized and fractures are common In the worst cases the vertebrae collapse and cause gross spinal deformity Treatment should be directed towards protein anabolism and rectifying any possible defect in calcium Calcium lactate or calcium phosphate should be prescribed and liberal amounts of milk encouraged It is now advised to try therapy with both male and female sex hormones 25 milligrams of testosterone propionate may be given intramuscularly thrice weekly together with diethylstilboestrol, 1 milligram daily, undesirable side effects are unlikely to occur if the ratio of androgen to oestrogen is 40 1 In addition, vitamin D may be administered Stilboestrol apparently causes calcium retention in aged males only if they have osteoporosis (Bogdonoff, Shock and Parsons, 1954)

Iron deficiency

Anaemia from this cause is more frequent in the elderly than at other ages and is frequently caused by repeated occult bleeding combined with low dietary intake of iron In at least 11 of 25 old persons having microcytic iron-deficiency anaemia the cause was a poor diet resulting from low income, from apathy or from living alone (Hobson and Blackburn, 1953), many of these cases can be improved by administration of iron (*Hobson and Pemberton, 1955*)

Vitamin deficiency

Apart from vitamin B_{12}, there is no evidence that vitamins are required in greater amounts amongst the elderly Deficiencies however may arise secondarily to restricted diets through inability to purchase and prepare food or to diets such as the Sippy treatment of ulcer or restricted diets for hypertension Deficiencies are also produced by the administration of antibiotics and sulphonamides There are no special problems of diagnosis but certain considerations should be mentioned Senile glossitis may be caused by deficiency of B vitamins and so may achlorhydria which is particularly common in the elderly Vitamin deficiency again may be

therapeutically They are quite different from the calf-tenderness that is so characteristic a sign of deficiency of thiamine, and no vitamins are useful in treating night cramps Quinine sulphate, 0 3 gramme, taken at night may be helpful.

Special foods

[illegible]

TABLE XXXII
Milk Diet
(High in protein, low in fat)

Analysis		Allowance for normal sedentary man, 60 years and over
Calories	2190	2000
Protein	108 grammes	72
Fat	14 grammes	90
Carbohydrate	407 grammes	—
Iron	9 milligrams	10
Calcium	3330 milligrams	750
Phosphorus	3150 milligrams	1000
Sodium	2240 milligrams	2000
Potassium	2060 milligrams	—
Vitamin A	1580 international units	2500
Vitamin D	60 international units	200
Thiamine	3 1 milligrams	1 0
Nicotinic acid	10 3 milligrams	10
Riboflavin	6 2 milligrams	1 5
Pyridoxin	3 milligrams	? 1 5
Pantothenic acid	20 milligrams	? 5
Folic acid	0 2 milligrams	? 0 2
Vitamin B_{12}	6 micrograms	? 1
Ascorbic acid	100 milligrams	30
Choline chloride	1300 milligrams	? 300

Constituents

Skimmed milk	1000 grammes	Orange juice	From two oranges
Skim milk powder	150 grammes	Brewer s yeast, powdered	20 grammes
Eggs	Two	Salt	5 grammes
Glucose	250 grammes		
Total volume	about 1500 millilitres		

calcium and phosphorus are high but the [illegible]

Atherosclerosis

The relation of this to dietary cholesterol and dietary fat has been discussed above Nothing is gained by reducing dietary cholesterol and something is lost since eggs and milk are good foods for the elderly But every reasonable attempt should be made to increase the dietary content of essential unsaturated fatty acids and of vitamin B_6, and to decrease the ingestion of highly saturated and abnormal fats Bread and flour of high extraction without chemical "improvers", and natural animal and vegetable oils contribute to this although the relative potency of such oils varies greatly, bacon fat is an excellent source

Hepatic cirrhosis and alcohol

Alcohol in moderation is useful for the elderly, it stimulates appetite, is a carminative, relieves worry and boredom, provides a few calories and makes life pleasanter for them largely by its narcotic and sedative action It is contra-indicated in arteriopathic and senile dementia, obesity and in liver disorders, it should not be used for treating insomnia

Dietary protection of the liver has very recently been summarized by Best, Lucas and Ridout (1956) Hepatic cirrhosis is probably usually a combination of over-nourishment and under-nutrition, calories are excessive and protein foods insufficient with the result that lipotropic substances (methionine, choline, vitamin B_{12}) are deficient Diets very high in protein (150 to 200 grammes daily) supplemented with choline and sometimes also with methionine have been used in patients with hepatic cirrhosis, but there is some evidence that they are harmful and may produce acute cerebral signs The best treatment is with a diet rich in good quality protein (for example, 100 grammes daily), low in fat and supplemented in severe cases with choline

Diabetes mellitus

This is frequently associated with obesity It is possible that hyperphagia over a long period exhausts the insulin secreting cells of the pancreas If the diabetic is obese, reduction in body-weight is very desirable and usually reduces the need for insulin therapy

Constipation

For reasons already mentioned this is common in the elderly, but it is also a frequent complaint when not present, elderly persons on diets low in calories and in bulk may normally pass stools only every second or third day Dietary treatment of constipation is easily achieved in some cases by including foods that are mildly laxative (such as prunes or brewer's yeast) and those that provide soft bulk (such as green and root vegetables) In other cases small simple enemas given twice weekly are necessary to avoid faecal impaction

Night cramps

These are common in the elderly, coming on suddenly at night in the calf muscles and persisting night after night for a period, then disappearing suddenly only to recur again Their cause is unknown They are almost certainly not a result of deficiency of calcium, though calcium lactate or calcium phosphate may be tried

edentulous, and soft bulk may be desirable to prevent constipation. The old, with a life-time of experience behind them, have deeply ingrained principles and prejudices, their habits are difficult to change, and their likes and dislikes may cause difficulties Tact and tolerance are required to ensure their co-operation and achieve proper nutrition

ACKNOWLEDGEMENTS

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before administration since, although no cooking is required, ascorbic acid is unstable.

If essential, intravenous feeding can be achieved with a number of mixtures; one is recommended by Rice and Strickler (1952). Another formula is given in Table XXXIII; this contains no fat or fat-soluble vitamins, no iron and negligible calcium.

TABLE XXXIII

FORMULA FOR INTRAVENOUS FEEDING

Glucose	200 grammes
Protein hydrolysate	75 grammes
Sodium chloride	7 grammes
Potassium chloride	3 grammes
Thiamine hydrochloride	2 milligrams
Nicotinic acid amide	25 milligrams
Riboflavin	2 milligrams
Pyridoxin hydrochloride	2 milligrams
Calcium pantothenate	2 milligrams
Ascorbic acid	50 milligrams
Water	to 1500 millilitres
This contains 1050 calories	

General dietary principles

Special mention must be made of a recent nutritional study of the elderly. The caloric intakes found by Bransby and Osborne (1953) have already been mentioned. This study was part of a detailed investigation of old men and women in Sheffield by Hobson and Pemberton (1955) who found that mental factors characteristic of the elderly such as apathy or forgetfulness might adversely affect health by leading to a monotonous and inadequate diet which in turn might result in wasting and malnutrition or in severe cases to deficiency disease They found that those living alone ate less of foods requiring some preparation than those living as married couples "In the big cities, the admission to hospital of old people with severe malnutrition, including nutritional anaemia, is fairly common and the old man who has scurvy is no great rarity. The reasons for this are poverty, ignorance and apathy Those existing on a meagre retirement pension calculated to cover only the necessities of life are the first to suffer when the cost of living rises Lack of knowledge of what food to buy and how to prepare it is most likely to affect the elderly man who has recently lost his wife. He tends to live on a diet involving little preparation such as tinned meat, biscuits, jam, and tea with condensed milk. It is understandable if in some cases the husband or wife who is left to live alone ceases to care about his or her diet, appearance or surroundings, and becomes in consequence ill and decrepit. The increasing use now being made of health visitors for advising and encouraging old people in this sort of situation and of the "meals on wheels" service are valuable preventive measures "

General dietary principles have been discussed in the course of this chapter. Old persons tolerate large meals poorly, and therefore three or four meals daily should be encouraged. Fats and fried foods should be discouraged, and foods rich in good quality protein encouraged A soft diet may be necessary if the person is

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CHAPTER 14

PHYSICAL MEDICINE IN THE TREATMENT OF THE ELDERLY

BASIL KIERNANDER

WITH THE ASSISTANCE OF MISS R WHELLER AND MISS D M TRUMPER

DURING the last 20 years there has been a radical change of outlook in this specially Today the most important aim of the physical medicine specialist in dealing with old people is to keep them as mobile as possible and, as far as practicable, to maintain their personal independence This calls for teamwork both in the hospital and at home

In hospital, the physical medicine specialist, along with his other medical colleagues employs the services of physiotherapists, remedial gymnasts, occupational therapists, ward orderlies, almoners and other social workers, all of whom combine to stimulate the patient to become active and interested in doing all he can for himself

As a very large number of these elderly people of necessity have to be cared for in their own homes, a comparable programme should be planned to take advantage of their relatives who can be trained to help them considerably in the home and who must, therefore, be taught not merely how to supervise their active movements, but how sympathetically to sustain them in the right psychological outlook

By organizing such a programme, it is possible to reduce the number of patients in institutions which were formerly inhabited by the so called "chronically ill", and to enable the limited hospital bed space to be used more usefully

When encouraged in this way to take a real interest in living the elderly patient will lead a very much happier life without being a burden to relatives or to the community

The aim of this chapter is to give some practical examples of the teamwork in geriatric rehabilitation Examples will also be given of programmes for the most common causes of disability in these old people Before progressing to this more practical aspect, however, a discussion of the implications of the advances of medical science and of the economic and social changes that have taken place in the consideration of old age will help to put this problem of geriatric rehabilitation into a clearer perspective

CHANGES IN MEDICAL PRACTICE

As Himsworth emphasized in the Linacre Lecture in 1955, few persons are able to keep fully abreast of the advances in modern medical practice and so apply to the maximum advantage all the benefits which are now available For this reason a review of some of the various ways in which the practice of medicine has changed in recent years will not be out of place, though of necessity the appraisal must be brief and will be confined to those developments which have influenced the practice of geriatrics and physical medicine

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that the nation will demand a lessening of the economic burden due to sickness and disablement

Adding "life to years"

The prolongation of life is no virtue in itself and the problem should be viewed rather as one of making the years that are left to our aged patients as happy as [illegible]

[illegible] object of geriatric rehabilitation admirably when he said "Seek to add not years to life, but life to years"

A simple example is to be found in the rehabilitation of a patient with an osteo-arthritic hip Walking re education would normally precede stair climbing but if the patient's [illegible] negotiation of stairs the pro- [illegible] the changes in the social and economic aspects of old age

Changes in the social and political philosophy of our times

Social and economic aspects of old age

The second world war can be considered a milestone in the social history of the British nation In particular it forced upon us an acceptance of the vast industrial potential among the sick, disabled and retired population The sudden manpower shortage revealed to some extent the useful work of which disabled and retired persons were capable

Among younger persons the value of a planned course of rehabilitation in shortening periods of sickness and in compensating for disablement was clearly demonstrated The need for an approach to the patient as a whole and for the integration of medical, social economic and industrial aspects of ill health became apparent

The introduction of the National Health Service in Great Britain, together with a more comprehensive system of social security in 1948, disclosed first of all an unexpected amount of real sickness which had been hidden, probably by financial reasons either through the direct cost of treatment [illegible] which the [illegible] formed the hard core of the hopelessly disabled

Two important lessons can be taken from this

(1) The vast majority of disabled people can normally be employed [illegible] capacity Employers generall [illegible] to person there is less opp [illegible]

(2) There is only a relat [illegible] number need help, if they [illegible] adequately resettled

Effect of full employment —The effects of an era of full employment must now be considered because this can be said to have made possible the economic and

Two major factors have been responsible for the great changes in medical practice (1) The rapid advance of medical knowledge, and (2) changes in the social and political philosophy of our times

Rapid advance of medical knowledge

The advances in medical knowledge have had three main effects

(1) More accurate and detailed diagnosis of disease and a more thorough study and understanding of pathological processes

(2) A widening of the range of diseases which may be successfully treated

(3) Decreased mortality rate from various diseases and the improved health of the population resulting in an increase in the expectation of life There is a trend towards an ageing population which it is forecast will result in an increase of over 50 per cent in the numbers of the population over the age of 65 years between 1947 and 1977

As examples of this trend towards an increase of aged persons in the population figures from three sets of statistics are quoted The first is taken from the report on the last census in Great Britain (1951)

Population over the age of 65 years 1947 – – –	5,000 000
Estimated population over the age of 65 years 1977 –	8 000 000

The second consists of those for the life expectancy in the Province of Ontario in Canada, where in the past 50 years this has increased by 19 years for the female, and 17½ years for the male

In 1901 there were 120,000 persons aged 65 and over in the provinces In 1921 there were 172,000 and by 1941 it was up to 301,000 The number of people in the age group 65 and over has doubled in the past 25 years It is estimated that in 1961 it will be up to 500 000 and by 1971 12 6 per cent of our population or one in eight will be 65 years or over (Silverstein, 1954)

The third set of figures from the United States of America, is as follows

In 1940 in the United States the 26 5 per cent of the population over 45 years of age required over half of the nation s medical care By 1980 50 per cent of the population of the United States will be over 45 years of age (Rusk, 1953)

These figures illustrate how rapidly and considerably the problems of old age may be expected to increase and they emphasize the urgent need for a workable solution of this complex and difficult problem

Increase in morbidity

An important aspect of the national trend towards longevity is an absolute and relative increase in morbidity and, since old people suffer more from disease than the young, it is obvious that the health of the aged and care of the aged sick are problems of increasing importance which must now be faced "Dublin has shown that, as compared with the average rate of 11 per 1,000 at all ages, the number of invalids per 1,000 was as follows 53 5 at ages 65 to 74, 72 7 at 75 to 84, and 106 2 at ages 85 and over" (Cosin, 1955) Since the advent of the Welfare State in Great Britain, the financial burden has been, to a large extent, transferred from the individual to the state and consequently it must be expected

INTEGRATION OF AVAILABLE SERVICES

While it is clear that much more can be done for ageing patients, the considerable problems of the integration of the services available are perhaps the most urgent It is, however, against this background that the department of physical medicine has emerged from those of massage, electrotherapy, actinotherapy, and balneotherapy The repute of these older departments was questioned by many and if progress in the field of physical medicine is to keep pace with the needs of the times it is important that the wider scope of the department be appreciated by all sections of the profession

It is, therefore, encouraging to be able to say that the acceptance of the principle of geriatric rehabilitation has been one of the most striking recent advances in the care of the aged The process of rehabilitation may to a large extent concern the

specialization is so difficult Yet, without this co ordination and integration so much time effort, and money is wasted and the patients can seldom achieve maximal functional recovery

MEDICAL REHABILITATION

In this respect O Malley s (1953) definition of the term 'medical rehabilitation'' is of interest

> Medical rehabilitation is the process whereby a man is made mentally physically socially vocationally and economically equivalent to his state before he became sick or injured It is a philosophy of living an attitude of mind on the part of the medical profession and public alike It is not concerned with the minutiae and technicalities of apparatus used in physical medicine

This is by no means a new concent but it is one that

it would be unreasonable to expect a patient to be unaffected by his illness and rather than aim at return
principle of doing the best fc
factors mentioned should be
succeed) to turn illness to the

Multiple pathology

It is vital to remember that in the elderly a number of pathological processes are at work A successful programme of rehabilitation must take all these into consideration but even in the old there are considerable reserves from which

humanitarian reclamation of these 90,000 disabled persons However, it is the fear of creating unemployment for the young which has brought about opposition to increasing the normal retiring age from trade unions and elsewhere Superannuation schemes and increased morbidity account largely for the reluctance of employers to start employing the middle-aged or elderly worker.

Medico-social problem of old age

The importance of the medico-social problem of the aged has been recognized and has received much attention in recent years, and already much has been achieved at all levels in an effort towards its solution A change of outlook has appeared in the hospitals for the aged sick As Nisbet (1953) said "The old chronic hospital has emerged from the doldrums" On the same subject Cosin (1953) drew attention to some of the various factors which had been responsible for the old "misconceived passive attitude of acceptance of the inevitable"

Until recently two basic errors were committed The first was the facile acceptance of the inevitability and irreversibility of pathological processes in the elderly It was no fault of the medical profession, however, that in the absence of mercurial diuretics, the sulphonamides, and the later antibiotics, certain serious illnesses in old people were more common, and recovery rare The routine use of these therapeutic agents has necessitated a complete reassessment of the care of the elderly within the last decade Mortality has been so reduced that the problem of morbidity in the elderly and some means of its estimation have become of paramount importance For unless physical medicine solves the problem of geriatric rehabilitation a grave crisis must arise in providing sufficient hospital beds, not only for this age group but for others also We see, then, that apart from the obvious benefits of geriatric rehabilitation to the patient and his family the pressure on hospital beds may be thus diminished

The second and more serious error was the failure to ascertain or be aware of the possibility of a restoration of physical activity in patients with crippling but not fatal conditions The problem of long-term illness was then handed over to the nursing profession to handle as best it might

Recent Government policy.—That the modern trends are appreciated by the Government and their importance understood is most clearly demonstrated by the recent Treasury statement (1955) agreeing to the appointment of men and women between the ages of 40 and 60 years of age to pensionable posts in the Civil Service

The statement explains that "This arrangement fits in with the Government policy in the employment of older men and women It also takes account of the changing age distribution of the population and need to make the fullest use of the Country's manpower in conditions of full employment It is to be hoped that all sections of industry and commerce will be encouraged to adopt this attitude soon

These changes in the hospital and in Government policy have not been accompanied to the same degree by the application of recent knowledge to the patient in the home The "simple" adaptation of the home with consequent considerable savings in nursing and welfare expenditure on disabled and feeble old folk is, however, beginning to receive increasing attention

(1) The maintenance of health and the prevention of disease by physical methods

(2) The application of various physical methods in the diagnosis of disease and in the assessment of function

(3) The use of physical methods in the treatment of disease and in the conservation and re-establishment of function, while acknowledging that in the majority of cases of major illness or disability, physical methods can be fully effective only if co-ordinated with the full programme of medical care and related to the needs and particular problems of the individual patient

Assessment of future functional status

However, before treatment is commenced the future functional status of the patient must be forecast and one should be able to give a tentative answer to questions such as the following (Lorenze, 1954)

(a) Will the patient be able to walk and climb stairs? Will he need such aids as braces or crutches?

(b) If not, will he be self-s...

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(f) Will the patient be able to return to his original occupation, or to another job compatible with his residual limitations?

Physical methods of treatment

The physical agent chiefly employed in the treatment of the elderly is exercise Other methods such as heat and massage aid relaxation and help the systematic relief of pain and can thus be employed as a preliminary to active exercise.

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one can draw with careful planning to enable the elderly to become active and to maintain as great a personal independence as possible Happiness of the elderly is greatly increased by this feeling of independence The medical team should, in all cases, study carefully the psychological approach to these patients to be sure that the domestic aspect is not neglected, as so much can be done by encouragement of relatives, neighbours and social workers

MANAGEMENT OF PROGRAMME OF REHABILITATION

So far no mention has been made of particular advances in our knowledge and treatment of the aged It must first of all be shown in what directions these lie and then the question of when they can best be applied can be discussed

Within the concept of rehabilitation this need can be solved, but it still remains to decide who is to direct and manage the programme throughout, as distinct from those specialists who must needs take charge at varying stages of the illness

That the general practitioner should remain the patient's counsellor and friend throughout the course of an illness is essential It is, however, unrealistic to suppose that he will have the time or special knowledge to co ordinate a major therapeutic programme The specialist, on the other hand, has narrowed his interests, of necessity, and may be responsible for only one part or stage of the process Moreover, he cannot always have the same opportunity to assess functional capabilities and relate the patient to his environment It has been suggested that the specialist in physical medicine is more favourably placed than other hospital consultants, situated as he so often is between hospital and domiciliary treatment, and with such an interest in the assessment of function and resumption of functional activities

Such a solution might be attractive to some, but the author feels most strongly that the answer must be found in the closer co operation of the various members of the medical team and that opportunities must be made for round table discussions on mutual difficulties and for case conferences when all concerned may, with the patient, work out the remedy Such conferences are of course only necessary in a small minority of cases and similar diagnostic problems are already frequently dealt with in this fashion In this way a useful liaison is built up and mutual understanding and co operation fostered

ROLE AND SCOPE OF PHYSICAL MEDICINE IN THE TREATMENT OF THE ELDERLY

Function of physical medicine department

Many attempts have been made to define the meaning and scope of physical medicine and there can be little doubt that to do this briefly and clearly is indeed a difficult task That it has a wide scope which overlaps considerably with other branches of medicine is generally agreed and it is for this reason that the specialist in physical medicine must always consider himself a member of a team whose ultimate task is the rehabilitation of the patient If the fact that it is impossible to divorce physical medicine from the general therapeutic approach to the patient is accepted, then the function of the physical medicine department may best be summarized as follows

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from bed to wheel-

an institution, such as a boarding home, nursing home or chronic disease hospital be necessary?

(f) Will the patient be able to return to his original occupation, or to another job compatible with his residual limitations?

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Heat treatment

Special care is needed in the use of heat treatment in old people because of lessened skin sensitivity. There is a special need to be careful in patients suffering from peripheral vascular disease, diabetes or nervous lesions in which sensation is impaired Thermostatic control at 94° F is probably the safest way of applying heat We must recognize also that arteriosclerotic blood vessels react abnormally to heat They either do not respond at all or else they have a prolonged contraction resulting in cramp Old people stand chilling and over-heating equally badly, therefore extremes must be avoided and great care taken in the use of heat or cold

A warm bath *at a temperature of from 94° F to 98° F is a most useful sedative* measure

The benefit obtained at spas is probably due to the regimen adopted rather than to any specific therapeutic value of the waters

Ultra-violet light is probably of little true value in the elderly despite the fact that it is often used for this purpose In fact it is probably contra-indicated as it is liable to produce severe humitus in old people

Diathermy must, like other forms of heat treatment, be used with extreme caution where there is arteriosclerosis or hypertension

Massage

Massage is often of great benefit to the elderly when they *are confined to bed* Abdominal massage may be particularly useful in chance constipation due to the temporary immobilization It should not be used when there is arteriosclerotic degeneration of the arteries of the lower extremities

Application of physical methods to postural defects in the elderly

The commonest postural defects resulting from the body mechanics of the elderly were well summarized by Harsson (1954) who placed them in the following categories

(1) Forward flexion of the head and neck with osteoarthritis of the cervical spine causing radiculitis in the upper extremities The correct therapeutic approach is by means of exercises, helped by traction of the cervical spine

(2) The round back deformity with round shoulders, depressed thorax pain in the shoulders and decreased vital capacity The treatment consists of exercises and correction of the posture before a mirror

(3) Low back pain, mechanical or postural in origin resulting from an unstable fifth lumbar vertebra Exercises are prescribed to tone the abdominal and gluteal muscles and for the correction of the pelvic tilt

(4) Short hamstring muscles which tilt the pelvis backwards and flex the knees, producing a shuffling gait with short steps Quadriceps exercises are those used in these cases, *together with gentle stretchings of the hamstring muscles which can be helped by* massage and heat

[illegible] in the calves of the legs when walking but relieved during rest [illegible] and has its origin in arterio [illegible] ogy of this condition Buerger s [illegible] ut by the patient lying on his back with the legs raised to 45 degrees for two minutes he then lowers his legs over the

be told that their symptoms give a warning as to the amount of activity they should undertake

ORGANIZATION OF A GERIATRIC UNIT

Ward groupings

The organization of a geriatric unit requires, from the point of view of physical medicine, a flexible attitude of mind towards the rearrangement of the hospital. Within the unit there must be ease of transfer of patients from one ward to another according to their condition and their scheme of treatment. It is impossible to handle patients who are scattered in different wards, and they should be grouped as follows: (1) Senile or irremediable and bedfast; (2) acute geriatric; and (3) ambulatory. This is not so much for the patients themselves but for the physical

also, for the collection and assembly of all apparatus required in their treatment, and prevents time and energy being wasted. At the same time it enables the occupational therapist and physiotherapist to arrange a joint timetable. They are then both on hand when required by the physical medicine consultant.

Senile or irremediable wards

The initial point to be faced is that most of these patients will probably never get out of bed again, although there may be a small number who will spend part of the day in chairs. The main care then will be from the nursing angle. There may, however, be a small percentage who could eventually be trained to be more mobile.

It is because of this small percentage that the physical medicine consultant, the physiotherapist and the occupational therapist must carry out a ward round at least once a week for the purpose of assessment. However, from a psychological angle a regular daily ward class conducted on these wards does much to alleviate boredom and stimulate some slight interest in living.

Suitable exercises.—Examples of exercises suitable for patients in this environment would be simple arm movements to music followed b

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Contractures and bed sores.—Although the elderly find splints or traction very tedious and worrying, contractures must be dealt with, simply because a contracture implies a pressure on an area which may not be able to stand it, for

example acute hip flexion by tilting the pelvis backwards causes pressure on the skin over the sacro-iliac joints Bed sores will be dealt with by ultra-violet irradiation and dressings, but everything else will come under the heading of nursing care *Should any improvement in mind* and body occur, the patient should then be transferred to the ward reserved for that particular level of improvement

Acute geriatric wards

The physical medicine work carried out here should aim primarily at maintaining the range of joint movement in the arthritics and stretching contractures in the hemiplegics The physiotherapist merely marks time until the patient's general condition permits more vigorous activity

Breathing exercises will play an important part, and particular emphasis must be placed on lower costal and diaphragmatic work Static contraction of all anti-gravity muscles must be attempted, and general encouragement given to move about in the bed The arthritic hip case can benefit at this time by gentle pendulum exercises supported in a Guthrie-Smith sling Alternatively an ordinary roller skate with a small plaster footpiece can be used, running on a piece of board two feet by three feet, the plaster footpiece can be made very easily and it is wise to make it larger than strictly necessary as it can then be utilized for several patients by merely changing the thickness of the brown wool lining

All concerned, the physiotherapist, the occupational therapist and the nursing staff must work in close co-operation to arrange a programme so that the patient will not be overworked This can be done by alternating activities It is important to remember that many patients on these wards are anxious about their condition and appreciate the opportunity to talk about their anxieties whilst working with the therapists

Ambulatory patients

The treatment of this type of patient is divided into two phases (1) Treatment in the wards, and (2) treatment in the department Each patient will be treated twice a day at the beginning, once in the ward and once in the department As soon as he or she is able to walk unaided the work should be done entirely in the department to save staff time

Treatment in the wards

Self-dressing

The first thing to be taught is self-dressing, and whether this is done by the physiotherapist or the occupational therapist is immaterial A useful preliminary to self-dressing is practice on a buttonhole frame, which consists of a small old picture frame with cloth tacked around it but split down the middle with buttons and buttonholes attached Lacing frames of a similar pattern can also be constructed

Long-handled shoe horns, elastic shoe laces, stocking pullers-on and long-handled brushes and combs can be used, instructions must, however, be given in the use of these, most of which can be constructed at very little cost Once the patient has achieved *this degree of proficiency, dressing daily is compulsory* Above each bed permanent tubular steel struts should be fixed The carrying of

Guthrie Smith slings from bed to bed wastes considerable time, and whenever possible permanent fixtures should be used with the slings hooked up in position and remaining there Exercising in these slings will be done as a daily treatment

Learning to stand

The earliest exercise of all, apart from sliding work, is to stand, and this is best achieved by the patient being placed in a plain wooden chair at the foot of the bed with, at his feet, a thin bar of wood braced against the bottom legs of the bed, the top of the bed being against the wall The patient grasps the bed rail and pulls himself up to the vertical position This is a much better method of getting the

with helpers can at this stage destroy, or at least mitigate against this self reliance The patient can be left for a little while in this position in perfect safety The next stage will be a side step to alternate sides, returning to the mid position to rest

Walking—the use of apparatus

A walking chair with adjustable hand grips may be used, although personally the author has found that the amount of space available in a ward is not adequate for excessive use of this machine Also it does not encourage the feeling of self-reliance, but if it is found necessary to use it a great deal a gymnasium with its increased floor space provides a better environment

Tripod sticks are excellent not only for the hemiplegic and the arthritic but also for the unsteadiness of senility They are light and easy to use

Quadriped sticks (4-legged sticks) have the same indications and the choice lies in personal preference

An elbow crutch with a gutter support for the forearm is useful for those patients with crippling hand deformities,
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Hand rails should of necessity be provided in all corridors leading off geriatric wards an important point not often
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Chairs for use in the wards

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Apparatus

Stationary bicycle—The use of the stationary bicycle may seem limited but there are many variations of it. The bicycle used in a geriatric unit department must be small and low and equipped with one wheel only, the front wheel The back wheel is eliminated and the pedals must be furnished with toecaps to prevent slipping The handlebars should be fairly high and not too far away from the seat Some types of stationary bicycles have no handlebars at all and can be used only for those patients whose chairs can be wheeled over the bicycle seat The support is then given by the chair arms This type of chair also wheels over a lavatory seat The chair with the swivel seat can be used to swing the patient on to the bicycle seat with the minimum trouble

There is another type of

fitted to a beam above the bed is not particularly suited to a geriatric unit, where cardiovascular disturbances and inability to do anything unusual is the rule rather than the exception

Straps to an overhead boom—As regards a corset or body belt with straps attached to an overhead travelling boom, such as is used in an x ray department, this has a very limited use in the re education of walking The elderly do not like the restriction of the body belt Also, if one accepts the principle that external aids are to be avoided in the attempt to train self reliance, this complicated piece of apparatus hardly warrants its setting up

Occupational therapy department

It is desirable that orthopaedic cases spend one session a day in the occupational therapy department and one in the physiotherapy department

By using large pieces of apparatus such as a rug loom which can easily be fitted with spec

are basketry, stool seating, netting brush making and various types of rug making

Domestic appliances—A kitchen unit is essential if rehabilitation preparatory to normal living in the home is to be attained This is not always possible owing to circumstances beyond the control of the authorities concerned, but living conditions today require that many elderly males may be left alone in the home all day and it is imperative that both sexes should have some preliminary training in managing for themselves

Many kitchen gadgets are simple and can be made easily and cheaply either by the occupational therapist or by the patients themselves in the department With the aid of these gadgets they can be taught to prepare and cook a meal The building up of the shafts of eating utensils is necessary in many cases when hand grips are defective This building up is most easily done by sliding a bicycle handle grip over the shaft, packing it tightly with cotton wool and making it watertight by waterproof adhesive tape

A special chair for the incontinent patient allows the patient to be up and about most of the day.

A chair to fix over a lavatory obviates a tremendous amount of trouble for both the patient and the staff, but it does require some slight supervision.

The hemiplegic chair with a single hand control in the form of two wheels, one superimposed on the other on one side. Gripping and turning both wheels at the same time produces a straight-ahead movement of the chair. A single wheel grip-and-turn produces a right or left turn according to which wheel is manipulated Some hemiplegics find this very confusing but with persistence they do learn.

Occupational or diversional therapy

Both in the senile or irremediable and in the ambulatory wards the occupational therapist is of enormous help, and it must be stressed that continual consultations as regards progress, change of treatment and the pattern of the patient's life must take place between the medical officer in charge, the physiotherapist and the occupational therapist

Treatment in the departments

Once the patient is able to dress and to stand up by himself, a daily visit to these departments is essential Psychologically it breaks down a little of the hospitalization feeling and it gives new social contacts with the outside world through the out-patients It produces a social sense which may assist general rehabilitation Also the increased activity will not only increase general circulation but does definitely improve muscle tone, with sometimes quite dramatic results in improved pelvic floor tone and consequent diminished incontinence

The main work in the department will be confined to (a) class work, (b) the use of more complicated apparatus, and (c) occupational therapy

Classwork

All patients come to the physiotherapy department in chairs, and most exercises will be conducted in those chairs A number of simple rollers fixed to the wall in a long line will permit training of hand grips, pronation and supination, the supervision being easily carried out These rollers have three sizes of hand grips as well as a series of screws for tightening, which allows for considerable adaptability

Group exercises—These are conducted in a circle with the physiotherapist in the centre and assistant physiotherapists or orderlies helping individuals with their disabilities All rhythmic work will be done to music and it is important for definite tunes to be associated with definite actions Bean bags and tennis balls are useful, to be passed from person to person (throwing serves very little purpose) or, in the case of hemiplegics, from one hand to the other hand Other movements, such as placing bean bags on the knees or head to counting will train precision and give variation Spindles of wood, rather like miniature clubs, can be used to train grips while performing arm movements Any movements simulating those of hair-brushing or combing will also be useful Pieces of thick string attached to the arm of the chair can be used for precision work by plaiting or tying

which stretches the flexors is extremely useful The occupational therapist will have given the patient a certain amount of guidance along the usual lines of hand work that can be done at home

These patients must report to the physical medicine specialist at stated intervals, when both physiotherapist and occupational therapist will be present at the examination and assessment, a complete revision of all exercises must be given at this time

Mobile physiotherapy

In districts where mobile physiotherapy vans are operating, the situation is entirely different The physiotherapist will not only be responsible for the progress of re education but also for seeing that the relatives are playing their part Reports will be made to the medical officer in charge, no situation under these circumstances can get out of hand

Patients in outlying districts

This group embraces those patients who are unable to attend hospital for re-checking owing to distance, and who are unable to be visited often for the same reason Here the instruction of the relative plays a much larger part The patient may have to remain in hospital for a longer period in order that a great degree of [illegible]

[illegible] muscle power returned and useful movement rather than exercise for exercise sake

EXERCISES FOR HEMIPLEGIC AND OSTEOARTHRITIC PATIENTS

The two commonest causes of major disability in the elderly are hemiplegia (Rusk, 1953) and osteoarthritis of the hips and knees Rusk states that with adequate rehabilitation 90 *per cent* of all hemiplegics can be taught ambulation, self-care urinary and faecal continence and 30 per cent can be taught to gainful work

Exercises for use by hemiplegic patients

In the wards

(1) All movements of the upper and lower limbs while supported in either Guthrie-Smith suspension frames, or in slings attached to permanent tubular steel fitments

(2) Self assisted elevation of affected limb by sling and pulley

(3) Overwriting The main head lines in the newspapers provide a copy-book Headlines only must be chosen because of the size of the lettering Th[illegible] pen must have a thickly padded [illegible] must be trained to [illegible] the 2nd and 3rd fin[illegible]

(4) Daily dressing

(5) For aphasia, it is helpful to train the patient on fundamental one syllable

Further domestic appliances are available to enable housework to be done with the minimum effort, for example a mop with a flexible handle can be used to clean under furniture, this can also be manipulated to clean at a high level while the patient remains seated A long handled dustpan is also on the market

Included in the kitchen unit are sinks wringers and a clothes drier The patients are encouraged to bring their personal washing to the occupational therapy department where they deal with it themselves and afterwards iron it

Shopping —If shops are at hand patients are encouraged to use them, accom panied by the therapist A visit to the hairdresser is likewise an excellent builder of morale

Living conditions after discharge home

Prior to discharge from hospital, the machinery will be set in motion by the Lady Almoners and the Home Care Organization to ensure adequate living conditions, but the job of the physical medicine expert comes before this it consists of interviews with and explanations to the relatives on whose shoulders the responsibility will rest in the future Clarity at this stage will save considerable trouble later on The importance of the self reliance of the old person is stressed as is the necessity of keeping up the main activities which the patient has done while in hospital, that is dressing every day, the performance of certain exercises and maximum activity possible The occupational therapist must follow up her patient who has been trained in the use of kitchen gadgets, and where possible identical gadgets should be fitted in the patient s own kitchen

Most of the problems of home care are dealt with in Chapter 16, but after all this has been implemented it is vitally important for the elderly patient who is within reach of hospital to attend for an assessment at stated intervals Where distance makes this impossible, a physiotherapist or occupational therapist should be available for visiting work reporting back to the physical medicine expert Backsliders should be re admitted for a short course of rehabilitation otherwise the initial efforts will have been largely wasted

Physical medicine in the home

Patients requiring physical treatment at home will fall into the following categories

(1) Those within reach of hospital
(2) Those in areas where mobile physiotherapy vans operate
(3) Those in country districts where distances are a problem

Patients within reach of hospital

In this group sufficient rehabilitation will have been given and the relatives are instructed to enable exercises to be carried out at home, the emphasis being placed on small domestic jobs as part of the exercises To combat the claw hand of the hemiplegic, cone shaped pieces of wood eight inches long are used daily the grip being taken on the thin end of the cone which is slowly pushed through the hand until the grip is stretched to accommodate the widest part of the cone Most domestic jobs re educate the flexors and therefore any mechanical device

which stretches the flexors is extremely useful The occupational therapist will have given the patient a certain amount of guidance along the usual lines of handwork that can be done at home

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the 2nd and 3rd finger, or 3rd and 4th finger ... example using the pencil between

(4) Daily dressing

(5) For aphasia, it is helpful to train the patient on fundamental one syllable

words, such as "yes", "no", "bed", "tea". In the later stages, reading one paragraph aloud emphasizing the consonants, is useful At least three or four attempts should be made with the same paragraph

(6) Occupational therapy, which is previously discussed in this chapter

Walking —The following training in walking should be carried out

(1) Getting up from a chair, *using the method of sitting at the foot of the bed,* with a wooden board on the floor and braced against the bottom legs of the bed The patient grasps the bed rail and continues to stand and sit This is perfectly safe, and can be practised for 20 minutes at a time and then progressed to side stepping in the same position

(2) Walking with a small weighted bag (1 – 5 lb) held in the hemiplegic hand The pendulum action of the bag simulates the normal arm swing of walking and therefore attempts to break the hemiplegic pattern

(3) Walking to music

(4) Stair training

When once the patient is able to walk, instruction in the bath-room is important, both as regards sitting on the lavatory seat and getting in and out of a bath, the latter being the most difficult The author has found it easier with some patients (depending partly on their bulk) to teach them to adopt an "all fours" position before attempting to rise This is a fundamental position and, as such, is comfortable and reassuring

In the home

(1) Use of cone-shaped piece of wood to straighten flexor contractures in the hand

(2) Daily dressing

(3) Holding on to a solid piece of furniture with the good arm and performing a pendulum swinging action with the affected arm The weighted bag mentioned in the ward exercises is useful to encourage greater range

(4) Sitting, resting both arms on a smooth table top, hands clasped, and straightening the elbows

(5) Sitting, arms supported on a table, tapping hands or fingers in time to the radio

(6) Washing out small articles, handkerchiefs, socks, and so on

(7) Sitting palms together on knees, flexing elbows and supinating as hands reach the face, followed by extension of elbows and pronation

(8) Handcrafts, learnt in hospital, which will make some definitely useful object, and therefore give incentive and a sense of achievement (As fingers may never recover, the emphasis must be on the elbow and shoulder)

As regards *foot and knee exercises a small pedal exerciser has proved excellent,* but most of the patient's activities in the home give sufficient exercise

Clonus may be a worry but the patient must be instructed to put weight on the foot, the moment clonus commences This can be done either sitting or standing and in *the majority of cases, the clonic spasm ceases*

A small pillow at the foot of the bed to take the weight of the bed clothes at night prevents pressure, and a toe spring may be necessary during the day to prevent tripping.

Exercises for use by patients suffering from osteoarthritis of the hips

In the wards

(1) All movements of the lower limbs while supported in a Guthrie Smith suspension frame The emphasis must be on abduction, internal *rotation and leg* lengthening

(2) Skating on a roller-skate fixed to the back of the heel, and either bandaged on, or fitting into a small plaster-of-Paris foot piece A cupboard-shelf makes an excellent platform on which to skate

(3) With the legs straight, separating the feet to marked points on the lower bed rail

(4) ... hip This can also be done on a

... he general condition permits, to

endeavour ...

(6) Daily

with their ...

must be used from the beginning and a long-handled shoe horn and elastic laces can make a patient almost completely independent

Walking —A tripod stick is best because of the greater amount of security it gives The progress then will be to ordinary sticks, unless the hands or arms refuse to take the weight Elbow crutches with adaptable hand grips are then the obvious choice, or those with a forearm gutter

Shoes will almost certainly have to be built up One is aware that building up a short leg may persuade it to adduct still further On the other hand, the pelvic rock and the jar of dropping down on to an arthritic leg always lead to lesions in the lumbar spine or sacro-iliac joints The best results are achieved in those patients who have built-up shoes but who continue to prevent further adduction by exercises and stretching

Bathing —Training in the bathroom will be given, as with the hemiplegic patient. With non articular types this is comparatively simple the same method ...

out of a bath ...

conditi...

A rubb... ... bath also contributes to safety

In the home

(1) Leg lengthening in bed

(2) Lying, knees bent but feet apart Bring the knees together while keeping the feet apart This will give a certain amount of ...

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or

...

ways in

(5)

defini...

(6)

... ... distance is measured, usually

something between 18 and 26 inches The patient stretches his adductors daily by edging his feet out sideways to these marks Chalk marks serve equally well but lack permanence.

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CHAPTER 15

HOSPITAL CARE OF THE ELDERLY

WILLIAM MORTON

INTRODUCTION

THE PROVISION of hospital services for the elderly is one of the larger problems arising from the increasing proportion of old people in the community

Morbidity increases with increasing years each illness tends to become more serious recovery is slower and often less complete The effects of repeated illness are cumulative and when an acute illness is added to existing disabilities prolonged incapacity frequently results In younger patients modern therapeutics has made it possible to treat many of the commoner illnesses at home In addition to the use of antibiotics the younger patient usually has relatives or friends to give the simple nursing attention required With the passing of the years friends become fewer and more feeble relatives more distant and the needs of the ageing patient are greater Because of the combination of medical and domestic strains often the *only* way to obtain suitable treatment for elderly patients is to seek admission to hospital This has created a greatly increased demand for hospital treatment for the elderly If as anticipated the proportion of elderly people in the population continues to rise the demand for hospital treatment will become disproportionately greater

Discharge from hospital often has to be delayed because of the same inadequacy of the domestic situation which necessitated admission The old cannot be hurried even out of hospital Bed occupancy and turnover figures depend on the average age of the patients as well as on the efficiency and enthusiasm of the staff

General practitioners have great difficulty especially during winter months, in obtaining admission to hospital of many of their elderly patients

This is not a new problem but it has now reached a new magnitude To appreciate the changes which are taking place it is helpful to look at them against the background of hospital services in the past

HISTORICAL

The earliest institutional care of the aged and infirm was probably that given in the monastic institutions many of which were founded in the ninth century About the same time almshouses for the aged were established by the Church and by craft and merchant guilds After the suppression of the monasteries by Henry VIII there is a gap in the history of hospital development until the refounding of St Bartho

It became apparent that some selection of cases was required. The reasons for this were well set out in a statement by the Governors of Guy's Hospital in 1732 in which they justified a change of policy:

> Incurable was of too large and indefinite a signification, and indeed, people generally understood by it such as laboured under distempers, loss of limbs, blindness and other natural and accidental deformities, and even age itself.

It was stated also that if the policy was not altered the "hospital must soon have become an almshouse" (Ives, *1948*). Thus, Guy's and St. Thomas's and St. Bartholomew's became acute hospitals.

When later, with the expansion of the great voluntary hospital movement, hospitals were established in many of the larger towns, these were essentially acute hospitals. For the reasons quoted above, they were unable to accept patients likely to require long-term treatment. At this time there was no alternative hospital system although the "Poor Houses" set up under the Poor Law Statute accepted cases of infirmity and destitution through age or other factors. These institutions were not intended to be hospitals, they were entirely custodial. There was no segregation, the aged, the sick, the frail, were housed alongside the destitute, orphans and even the insane. Not until the middle of the nineteenth century and then mainly through the great efforts of Florence Nightingale, was a general change effected and it was decided to segregate the sick from the destitute and the so-called "able bodied". The Act of 1867 provided for the setting up of Infirmaries to be controlled by the Poor Law Guardians but to be entirely separate from the work houses. This marked the beginning of a changed public attitude to the hospital care of the elderly.

Municipal hospitals

The Act of 1867 also marked the beginning of a second system, that of municipal infirmaries which was parallel to the existing voluntary hospital system. The municipal infirmaries were, at first, mainly responsible for the treatment of chronic illness.

Advances in medicine, even more in surgery, led to an increased demand for hospital accommodation, a demand which the voluntary hospitals alone could not meet. The infirmaries began to accept cases which hitherto had been treated in the voluntary hospitals. Surgeons were appointed, maternity wards were established and, when in 1929 the institutions were transferred from the Poor Law Guardians to County and County Borough Councils, many were already established as hospitals. Progressive local authorities built additional wards or even new hospitals, the best of these offered hospital accommodation and treatment in no way inferior to that obtained in the voluntary hospitals. These new developments were for the acute sick. The elderly and so called chronic sick were to be found in the least modern, most overcrowded wards, or accommodated in an adjoining public assistance institution.

The familar pattern was being repeated in the municipal hospitals, in that acute cases were beginning to displace the elderly and chronic sick. In fairness it must be said that in the municipal hospitals, although the wards were grossly overcrowded and the staff few in number, elderly patients were well cared for and the general standard of nursing attention was high.

War time developments

When the Second World War was inevitably approaching, the Emergency Medical Service was set up and a review of all hospitals was made Some municipal hospitals in so-called "safe" areas were up-graded and their patients re-classified When war started there was a mass evacuation of patients from many hospitals This evacuation included a number of elderly patients and to everyone's surprise it was found that a percentage of these could be returned to their homes Under the Emergency Medical Service scheme many consultants hitherto exclusively attached to teaching or voluntary hospitals were brought for the first time into contact with the conditions in the institutions They began to realize that here was a vast and neglected field of medicine of a very different type from that to which they were accustomed

The war ended and plans were made for the State to assume control of all the hospitals in the country This included the responsibility for the chronic hospitals as well as for the great voluntary and municipal hospitals

Hospital surveys

In reviewing hospital surveys the Chief Medical Officer to the Ministry of Health (1946) wrote that the plight of the chronic sick was emphasized in every report and quoted one which referred to "masses of undiagnosed, untreated cases of chronic type which litter our public system of institutions" In the survey of the Sheffield and East Midlands Hospitals (1945) the following statement occurred

> wi
> fa
> In ... if there is classification at all it is only the difference between incontinent wards and others

With few exceptions, the accommodation for the aged was inadequate, depressing and entirely unsuitable and there was very little prospect of new buildings to replace it in the near future The great majority of the patients were bedfast, a large proportion incontinent

Such was the state of affairs when the National Health Service took over responsibility for the hospitals on the 5th July 1948

LEGISLATION

In the National Health Act, 1946, and the National Assistance Act, 1948, local authorities were given *responsibility* for the provision of certain services, services complementary to the hospital care of the elderly The Home Nursing Service Health Visitor Service and the ...
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dati ... the provision of residential accommodation under this clause *For the* first time, by statute a distinction was

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(2) Long-stay annexes to provide accommodation and nursing care for the elderly patients found to be irremediable

(3) Residential homes for elderly persons not in need of nursing care but otherwise in need of help (this was partly covered by the provisions of the National Assistance Act)

A hospital geriatric service was a new conception and the early units were essentially experimental, they did not follow a set pattern, although many have eventually developed along the lines of the committee's report

Units varied in the accommodation provided but one common factor was that newly established units inherited chronic sick wards or hospitals filled with bedfast patients The first step, therefore, was the examination and classification of these patients

"Inherited" patients in 1948

For many patients the walls of their wards formed the boundaries of their world, within them they felt safe The atmosphere was kindly but pessimistic, the patients uncomplaining and uncritical and both staff and patients had accepted for the majority the inevitability of hospitalization for the rest of their lives Early attempts at more active treatment and measures of rehabilitation were met, not only with suspicion, but often with opposition To disturb these poor old people seemed ...

... his findings thus

Of the bedridden patients who form ... fraction (5 per cent) is there ... in the apathy of institutional ... fractures and deformities produced by long inactivity in bed, the lack of adequate treatment by physical methods, and the dissolution of homes are to a great extent responsible for the disaster

Amulree and ... patient ... 4 per c... of thos... ... end of the year only 10 per cent were permanently bedfast This compared to almost total bedfastness at the beginning of this review In a report by a special medical committee to the Sheffield Regional Hospital Board (1951) the following observation was made

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drawn between the sick elderly, the responsibility of the hospital service, and the aged in need of care and attention, the responsibility of the welfare authorities No longer should elderly patients need to be kept indefinitely in hospital simply because they were homeless Previously the aged sick, and the so called able-bodied and infirm elderly, were housed in one institution There was little incentive for patients or staff to strive for recovery

Under these two Acts, the ownership of the former Poor Law establishments was decided on "a main user" basis Institutions accommodating more sick than non-sick passed to the Ministry of Health, other institutions, where the non-sick predominated, remained under the control and ownership of the local authority Many had to remain "joint institutions", the ownership and administration of which was placed in the hands of the principal user but both hospital and local authority services were permitted to continue to make use of the institutions

DEVELOPMENT OF GERIATRIC UNITS

Pioneer units

In one or two hospitals a great change in the medical approach to the aged had taken place For a number of years Dr Marjory Warren at the West Middlesex Hospital had been re examining, classifying and rehabilitating her elderly patients She proved that many regarded as irremediable and permanently bedfast could be restored to some degree of independence A number responded so well that she was able to discharge them to their homes, others who made a more partial recovery were placed in an adjoining ambulant annexe (Warren, 1948) Early on she made an appeal that elderly patients should not be admitted to a chronic hospital until they had been examined and investigated in the wards of a general hospital (Warren, 1943)

Similarly, Cosin at Orsett Lodge, Essex, during the latter years of the war, found that with active treatment 37 per cent of the elderly patients admitted could be discharged and 14 per cent rendered ambulant and accommodated in long stay annexes (Cosin, 1948)

Howell (1943) from experience gained as Medical Officer to the Royal Hospital, Chelsea, began to evaluate the changes found on clinical examination in the aged

The subsequent growth of a hospital geriatric service owes much to the example and advocacy of the pioneers whose work gave a new outlook to the medical care of the elderly

Report of British Medical Association Committee

Structure of a geriatric department

A special committee of the British Medical Association (1947) advocated the gradual establishment in selected hospitals of special geriatric departments under the charge of a consultant The committee suggested that the geriatric department should consist of three sections

(1) Geriatric wards in a general hospital where elderly patients would be investigated, treated and rehabilitated and in due course discharged either to their own homes or other appropriate accommodation

In acute geriatric wards there is activity but it is activity at slower tempo than that in general wards with a high proportion of young patients Elderly patients appreciate the special arrangements made for them and prefer the tranquility of a ward organized for the slowing up which is inseparable from growing old

Long-stay wards

Figures between 1 5 and 2 0 beds per 1,000 population have been given as a proper allocation of long-stay (chronic) beds There is so little knowledge of the numbers of old people living in an area, whether or not they live alone, and whether or not some are in need of help, that it is difficult to find the evidence upon which these figures are based Also, the need for hospital accommodation varies in different regions, urban communities probably require a higher ratio than rural However, at present, the actual ratio chosen is little more than a theoretical exercise for it is seldom over 1 per 1,000, it may in places be as low as 0 4 per 1,000 The existing hospitals for the aged chronic sick, usually in ex-public assistance institutions vary from 10 beds in a village institution to 700 or more in certain towns

These buildings were not designed as hospitals Almost inevitably they were architecturally dismal, the wards either long and large or too narrow, the lighting poor, side rooms and treatment rooms practically non-existent Few had lifts

Many improvements have been made since the hospitals became National Health Service hospitals Decorations and lighting have been made brighter and more cheerful and facilities such as bed pan washers, improved kitchens and treatment rooms and lifts have been installed Black beds have been abolished and replaced by cream or coloured ones, bedside lockers and bed tables have been supplied Much has been done to improve the amenities of these buildings but the buildings remain As great a disadvantage as the unsuitable structure is the local past reputation of these institutions Though designated as hospitals and given new names, to local people, especially the older generation, the aura of the workhouse institution lingers on However, this is no longer so potent a deterrent as it was five or six years ago

Unfortunately, the Ministry of Health has chosen to perpetuate the name chronic" hospitals a designation which is disliked by patients and staff and a description which does not do true justice to the work which is being done in these hospitals today

In the acute geriatric wards the numbers of men and women admitted are about equal but many more women require long-stay accommodation This has been noted repeatedly (Adams, 1952 Morton, 1952 Gibson, 1955) and the usual ratio is approximately 2 1

The equipment and facilities described for the acute wards are required in the long stay hospital for treatment must continue there In addition, amenities such as wireless and television are appreciated and day rooms should be large and cheerful

Segregation of different grades of patients is usual, incontinent, bedfast patients in one ward, confused and restless patients, some of whom require cot beds, in another Patients still having active treatment, including physiotherapy, are probably better suited on ground floor wards In some long-stay hospitals specialized units

The problem had to be tackled on admission This led to the setting up of what have been termed "acute geriatric wards" or assessment and classification units As recommended in the report of the British Medical Association these units should be in, and part of, a general hospital Where this was not possible, part of a long-stay hospital had to be designated as an acute unit This appears to work reasonably well when, but only when, there is access to the departments of a nearby general hospital

Long-stay wards usually are in an adjoining building or in the same hospital building The acute and long-stay wards will be considered separately

Acute geriatric ward

A geriatric department does not treat all elderly patients admitted to hospital and there can be no specified or proportionate number of beds in the acute geriatric wards In practice, where there is one consultant physician in charge, 40 to 60 beds, equally divided between the sexes, has been found to be a workable unit The unit should form part of the general medical department of the hospital

The turnover in the acute wards will depend to a great extent on the number of long-term beds available, for without adequate long-stay accommodation the acute wards become blocked

It has been found that the longer an elderly patient is in hospital, the greater is the difficulty in arranging eventual discharge Unnecessary delay in x-ray and laboratory investigations and in instigating treatment must be avoided

One of the principles of geriatric medicine is to keep patients in bed for the shortest possible time This necessitates day room accommodation To sit patients in chairs beside their beds is not a satisfactory alternative Patients have group exercises, occupational therapy and opportunities for games and conversation in day rooms, all of which have therapeutic effect The patients who are up should have at least the mid-day meal sitting around a table If the table is some distance from their favourite chair the walk entailed has the advantage of being exercise with a purpose

Chairs should have arms and should not be low nor too luxuriously sprung Getting out of a deep, low chair is a very difficult task for an old person Beds should be of three types, the ordinary hospital bed for those requiring active nursing one or two cot beds for restless patients, seldom required after the first few nights and low beds for those patients who are to be encouraged to get up unaided Baths should be set low

Wall rails and wall handles in toilets are useful sanitary chairs essential A "cake walk" with hand rails is most helpful for early walking exercises because it allows walking practice in the ward without necessitating repeated journeys to the physiotherapy department

Nursing of elderly patients is always heavy work, therefore the geriatric wards should be given priority for all appliances such as bed pan washers and bath trolleys, which make nursing less arduous

It has been said that segregation robs elderly patients of the stimulus gained from mixing with younger persons, but this is not borne out by the desire almost always expressed, if readmitted, to return to the geriatric ward where they were treated previously

particular from the National Corporation for the Care of Old People and the King Edward's Hospital Fund One home, used mainly for the temporarily infirm has been described by Howell (1951), the results of another, a dual purpose home, caring both for the "supervised convalescents" and the "frail ambulants" were reported by Adams (1954)

These experimental homes have proved their worth, but the problem of caring for the steadily increasing number of aged persons in these categories must eventually become the responsibility either of regional hospital boards or local authorities and as these old people do not require skilled nursing this responsibility will probably fall on local authorities

SENILE CONFUSION AND MENTAL INFIRMITY

This is one of the great problems confronting the hospital service There is general agreement that elderly patients suffering from mental infirmity should seldom have to be certified under the Lunacy Act Mental infirmity varies from mild, often nocturnal, confusion to extreme restlessness, noisiness and even violence Between these ranges there is a very large group of elderly people suffering what has been called, though wrongly, senility The spell of mental aberration may be comparatively brief, though recurrent episodes of confusion and disorientation are common

Ministry of Health recommendations

In a Ministry of Health Circular (1950) it was recommended that short ...

... the patients would not be detained under Section 20 of the Lunacy Act ...
found to
hospitals
prepared

Many old persons quickly respond to psychiatric treatment and can thereafter be cared for by relatives Others do not require continued treatment, but merely continuous supervision, for these cases "half way houses" would seem to be required

PLACE OF A GERIATRIC UNIT IN A GENERAL HOSPITAL

Geriatric wards have no monopoly of the treatment of elderly patients Every department of a hospital, maternity and paediatric departments excepted, has to

for the treatment of hemiplegia, or cases of arthritis have been developed In others the ambulant and "near ambulant" cases are accommodated in separate annexes Patients with behaviour problems and those of senile dementia are segregated

Occupational therapy should be available in every ward.

Visitors

The majority of elderly patients when first admitted to hospital, that is to the acute ward, have regular visitors Relatives rally around, neighbours come in to see them and clergymen call, flowers are brought, other comforts are given and the patients often revel in the recrudescence of friendliness which their admission to hospital has evoked However, as time passes, especially when they are transferred to the long-stay hospital, the visits tend to become more widely spaced and the visitors fewer. A few have no visitors and theirs is a tragic plight Much can be done in these cases by *voluntary visitors from the local Old People's Welfare Committee*, a church, or the League of Friends It is particularly helpful if the visitor who has become a friend of an elderly patient will continue to visit that patient on return home This gives a sense of continuity of interest which is very important to the elderly person In the long-stay wards, especially those where patients are bedfast, but mentally alert, nothing gives greater pleasure than visits from young people It has been possible to arrange in some hospitals for youth organizations, Scouts, Girl Guides, boys' and girls' clubs, to arrange a rota of visitors

The long-stay hospital should never become entirely chronic Selection of cases in an acute unit inevitably leads to more and more irremediable cases and fewer of short-term illness, being transferred Even so, some cases will respond to prolonged treatment and the long-stay hospital should have a proportion of discharges as well as the inevitable high percentage of deaths

Half-way accommodation

Many elderly patients make only a partial recovery from the illness which led to admission to hospital and are left so infirm that they cannot be cared for satisfactorily in Local Authority Part III accommodation as at present organized and staffed This group was well described in the Annual Report of the National Corporation for the Care of Old People (1949)

> There is a category of old people which is the responsibility, apparently of no one, those in it are on the border line between health and sickness being neither fit enough since they may need days in bed, to look after themselves or to live in a Home for the able-bodied, nor yet sick enough to need hospital treatment There appears to be an administrative gap between the National Health Service Act and the National Assistance Act

There also is a category of elderly patients which would benefit from a spell in home betwixt hospital and hostel before being discharged, a home which would give more specialized treatment than a convalescent home

The two categories, differing in that one has a permanent, the other a temporary need of after hospital care, are often grouped together in "half-way houses" Numbers of these "half-way houses" have been set up in conjunction with hospital geriatric units and have received considerable support from voluntary bodies, in

particular from the National Corporation for the Care of Old People and the King Edward s Hospital Fund One home used mainly for the temporarily infirm has been described by Howell (1951) the results of another, a dual purpose home caring both for the supervised convalescents' and the 'frail ambulants'' were reported by Adams (1954)

These experimental homes have proved their worth but the problem of caring for the steadily increasing number of aged persons in these categories must eventually become the responsibility either of regional hospital boards or local authorities and as these old people do not require skilled nursing this responsibility will probably fall on local authorities

SENILE CONFUSION AND MENTAL INFIRMITY

Th e one f t

[illegible] confusion to extreme restlessness noisiness and even violence Between these ranges there is a very large group of elderly people suffering what has been called though wrongly senility The spell of mental aberration may be comparatively brief though recurrent episodes of confusion and disorientation are common

Ministry of Health recommendations

In a Ministry of Health Circular (1950) it was recommended that short stay psychiatric units and long stay annexes should be established

The psychiatric unit for short stay cases should be part of a geriatric unit in a general hospital The purpose of this unit should be to diagnose, assess and provide short term treatment the patients would not be detained under Section 20 of the Lunacy Act The long stay annexes should be for old people who were found to have marked behaviour disorder, they were to be associated with mental hospitals but preferably not part of a mental hospital The Minister would be prepared to direct that the long stay annexes sh [illegible]

[illegible] able buildings, [illegible] will be given for the early construction of

Many old persons quickly respond to psychiatric treatment and can thereafter be cared for by relatives Others do not require continued treatment, but merely continuous supervision for these cases half way houses would seem to be required.

PLACE OF A GERIATRIC UNIT IN A GENERAL HOSPITAL

Geriatric ward [illegible]
departmer

treat an ever-increasing proportion of aged patients The high incidence of fracture of neck of femur forms a special geriatric problem in the orthopaedic wards

Acute geriatric wards are usually part of the medical department and where emergencies are accepted into these wards in addition to waiting list cases all types of medical illnesses are found Many conditions previously regarded as diseases of younger age groups, such as peptic ulcer and rheumatoid arthritis, seem to be becoming increasingly common in the over-seventies However, two diagnostic groups preponderate, cardiovascular disease and disease of the central nervous system, in particular cerebro-vascular lesions

An interesting comparison between admissions over the age of 60 years to the (a) Geriatric units, and (b) other wards of a general hospital is illustrated by Fig 59

Long-stay geriatric wards accept cases from all acute wards, including the acute geriatric wards If there are not enough long-stay beds, the acute wards soon become blocked with elderly irremediable, and long-term treatment, cases

The geriatric unit is called upon to find suitable long-stay accommodation for surgical as well as medical cases The geriatric team should also be available to advise about problems arising on discharge of elderly patients from any department of the hospital

STAFF OF A GERIATRIC UNIT

Senior medical staff

Over sixty geriatric units have been established and in the majority a consultant physician has been placed in charge In certain of the larger units there is more than one physician, in others, usually chronic hospitals, which have been redesignated geriatric units, a medical officer of less than consultant grade has been appointed It is to be hoped that this policy will not be adopted generally because it suggests that the elderly do not require the same high standard of medical care as other patients

In some areas the physician has been given the title of geriatrician As geriatrics is a branch of general medicine and not a separate clinical specialty this title is not generally acceptable

The physician in charge has to devote considerable time to the organization of the hospital care of the elderly as well as to the practice of general medicine. Of particular importance is the close liaison with the officers of the local authority and of voluntary organizations Obviously, it is more convenient for one physician to undertake the organizational part of the work even though he is not engaged solely in the practice of geriatric medicine

The geriatric physician usually has charge of acute beds and of a considerable number of long-stay beds In some hospitals responsibility for the long-stay beds is shared among the general physicians Recently an appointment of a geriatric consultant has been made jointly between a local authority and a regional hospital board In this appointment he has responsibility both for elderly patients in hospital and for the old people in local authority accommodation It is hoped that this joint appointment may solve many of the difficulties which commonly occur, and that the physician will be able closely to co-ordinate the hospital and the

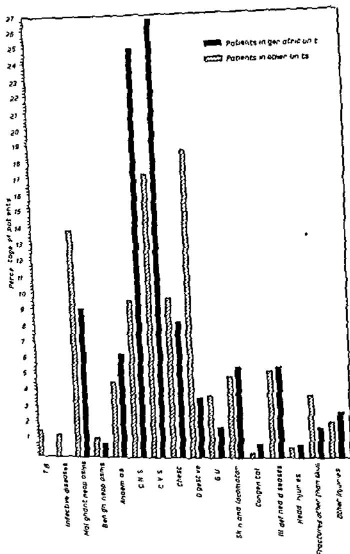


FIG 59.—Survey of 1 000 patients over 60 years of age (*By courtesy of Dr Exton Smith*)

welfare services This appointment is in a way experimental, the results obtained will be most interesting

The geriatric physician by lect ... ence ... ı do much to ... the elderly in ... hospital colleagues and patients ... about the combined social medical care of their elderly

Other medical staff

General practitioner clinical assistants

These have been appointed to many geriatric units and, apart from the fact that it is very difficult for them to cover emergency admissions, these appointments have been most successful Where units are small and scattered the day-to-day care of the patients has to be undertaken by general practitioners, but a consultant should always be available and should visit regularly

Junior medical staff

At first it was not easy to obtain house officers for geriatric units, especially if a large number of long-term cases was included However, recently there has been more competition for these posts and this is not surprising because the training obtained in a geriatric unit, and in long-stay wards, is invaluable either to the future consultant physician or to the doctor who intends to enter general practice

Nursing staff

Acute wards—The acute wards should have the same complement of trained and student nurses as the other general wards It is important for student nurses to gain experience of the methods and nursing techniques used in geriatric wards As elderly patients on the whole require more help, especially those in the first stages of ambulation, it is useful to supplement the nursing staff with orderlies, a kindly helping arm need not belong to a trained nurse or a nurse in training In many places the geriatric wards are still regarded as "chronic wards" This is wrong because these wards are turning over at almost the same rate as general medical wards An acute geriatric ward of 25 beds, plus adequate long stay accommodation should be able to treat 300 patients a year

It is said that these wards are difficult to staff but, once a sister has taken charge of an acute geriatric ward, she usually likes the work and becomes enthusiastic about her elderly patients

In a ward where the sister is enthusiastic, the junior nurses respond There are few branches of nursing which call for greater nursing skill or where the results can be so satisfying

Long-stay wards—It is essential in a long stay hospital to have a sufficient number of trained nurses In effect, this means a ward sister for not more than thirty patients, with reliefs of trained staff Under her there should be a number of State-enrolled assistant nurses and ward orderlies Male charge nurses have charge of many male wards The work is heavy and has not the glamour of a ward in an acute hospital Accordingly, long-stay hospitals experience considerable difficulty in obtaining the requisite nursing personnel This is true also of acute general hospitals in many provincial towns and one unfortunate recent development is that acute hospitals are beginning to attract assistant nurses to augment their depleted nursing staffs, thus denuding the long-stay hospitals of the services of State-enrolled assistant nurses Without part-time nurses many long stay hospitals would have to close down Also, part-time nurses with home or other interests

in addition to their hospital duties are more likely to enjoy working with elderly long term patients than a nurse whose life centres in the hospital

Incontinence is one of the heaviest burdens of nursing, but it is not nearly so prevalent as it was ten years ago Much of the incontinence of the past was due to mismanagement and to the fact that so many patients were allowed to become bedfast and disinterested

There is an art as well as skill in nursing long term patients Whether the patients are cheerful or lethargic, co operative, or noisy and troublesome depends very much on the attitude and ability of their nurses Bed sores are rare in chronic hospitals and this is a tribute to the standard of nursing

In many long stay hospitals assistant nurse training schools have been established but students, in the hoped for numbers, are not materializing

Hospital almoner

A geriatric unit cannot function without an almoner Whenever possible, it is a good policy for the almoner to make out a brief social history for each patient on admission By so doing she has early contact with both patients and relatives and can reassure them that the hospital will not "cast out" the elderly patients before suitable arrangements have been made The social history should include a report from a health visitor or notes of a domiciliary visit paid by a member of the geriatric team giving an assessment of the domestic situation These reports are as important as the medical history and if available soon after admission enable the physician to study the case in its entirety

It is essential that the almoner is kept informed of the patient's progress This may be done by the almoner accompanying the consultant on his ward round or by frequent discussion about each case When the time comes for the patient to be discharged various arrangements may have to be made and these arrangements cannot be effected in a day Home nursing or home helps may be needed, the loan of appliances arranged, or help from friends and neighbours organized Often it is useful to give the local authority health visitor a briefing of the patient's condition on discharge and ask her to carry on in conjunction with the general practitioner, the supervision of the case on return home

PHYSIOTHERAPY AND OCCUPATIONAL THERAPY

The scope of physical medicine in the treatment of the elderly is dealt with else where in this volume However, as physiotherapists and occupational therapists are important members of the hospital geriatric team, mention must be made here of the roles they play

To restore, or improve, mobility is one of the tenets of geriatric medicine Simple exercises in the ward, for example bottom of the bed standing drill, or walking in a cake walk, help many patients to regain confidence, but, at some stage of treatment instruction from a physiotherapist is needed Physiotherapy can also do much to strengthen weak muscles or loosen stiff and painful joints in addition to specific treatment for arthritis, and other diseases "Old age cannot be cured but its concomitant disabilities can be made tolerable and the remaining years more enjoyable (Morton, 1953)

Old people often live in old houses with steep and difficult stairs, the return home can be made safer by practising stair climbing before discharge from hospital

Occupational therapy is as essential as physiotherapy. Apart from the presenting illness which led to admission to hospital many elderly patients have been living rather sedentary and disinterested lives. When, under the direction of an occupational therapist, they make something, confidence is restored and pride in the finished article is out of all proportion to the skill exhibited in its making

The occupational therapist, dealing with the elderly should be fully conversant with the gadgets which are now on the market to help the paralysed and stiff-limbed. Return to the kitchen sink and cooker will be facilitated by training in a "gadget fitted" kitchen attached to the occupational therapy department

For the incurable and bedfast patients also the occupational therapist can do much to provide an escape from boredom and from fear of what inevitably lies ahead

Chiropody

Many old persons admitted to hospital are badly in need of chiropody which should be given under medical supervision

Speech therapy

The services of a speech therapist are at times required, especially for cases of cerebral thrombosis with initial aphasia, followed by partial recovery of speech

ORGANIZATION OF A HOSPITAL GERIATRIC SERVICE

Waiting list

There are not enough hospital beds, so a waiting list is unavoidable. The length of the list and time of waiting vary considerably, nor do these two factors indicate the efficiency of the local geriatric service. In some areas there is a very small waiting list, not because the hospitals can accept all patients referred, but because there is so little chance of obtaining admission for other than emergencies, general practitioners no longer request admission for elderly patients

What might be termed an annual "medico-social epidemic" starts in January of each year and waiting lists grow rapidly. Old people are easily defeated by severe frost and snow, they take to their beds, food and fuel run out and within a week they have developed broncho-pneumonia or in other ways have deteriorated so greatly that they become "hospital cases". There is no reserve of hospital beds and the increased demand occurs at the time when hospital staffs are depleted because of illness. If help could be obtained at home, speedily and when needed, many of these old people would not require hospital treatment

Admission from a geriatric waiting list cannot be in date sequence, both medical and sociological conditions have to be considered in estimating urgency or priority. The necessary information can be obtained by a medical member of the geriatric unit, usually accompanied by an almoner or social worker, visiting the patient at home. Information may also be obtained by notifying the Medical Officer of Health of the names on the waiting list and requesting social reports from health

visitors Perhaps the simplest method of all of obtaining information about priority is direct telephone communication between the general practitioner and the physician to the geriatric unit

The waiting list for elderly women is usually longer than that for men One reason for this is that old women linger longer in hospital and there is a greater demand for long stay beds for females There must, however, be other factors involved, factors which are not at present fully understood (Gibson, 1955)

It is most important to review and check the names on the geriatric waiting list at frequent intervals for changes in the condition of elderly patients happen with dramatic suddenness

Domiciliary visits

These are made with the purpose of assessing priority of admission on medico-social grounds and are not to be confused with domiciliary consultations requested by a general practitioner

The practice of home visiting was started by Brooke at St Helier Hospital, Carshalton, and results obtained in other areas have been reported by various authors (Amulree, and his colleagues, 1951, Exton-Smith, 1952, Greenwood, 1952, Howell, 1954) From figures given, approximately 80 per cent of patients visited required admission to hospital, of these 20 per cent to 40 per cent were in need of immediate hospital *treatment*

Geriatric out patients

Geriatric out patient sessions serve three very useful purposes, as follow-up, reference and consultative clinics The almoner must attend these sessions

Often there is some doubt whether elderly patients, especially those living alone, will make the grade *on discharge* from hospital Only by bringing them back for a follow up assessment can it be determined if the medical and social difficulties have been satisfactorily met

When a request is made to a welfare officer or to a voluntary organization for admission of an elderly *person* to one of their homes, it is not always easy for these officials on the information given to determine the suitability of the case, especially if there is some *physical* disability Reference can be made to the physician to the geriatric unit who *should* be *familiar* with the homes and the facilities available, and thus be in a position to advise Not infrequently it will be found that an elderly person *referred* would benefit from a short time in hospital for investigation and treatment *before entering* one of the community homes

Geriatric medicine must include prevention, or postponement, of the crippling disabilities of age A time comes *when* an old person begins to feel that he or she can no longer cope with physical *disability* and the bother of living At this stage often there is a medical condition for which something can be done, or it may be at this stage that the institution *of social* measures, such as arranging for a home help, may prevent a complete breakdown

A consultation where an effort is made to evaluate the difficulties facing the elderly patient, as well as to diagnose and treat the physical disability, can be of great value to the general practitioner, to the welfare authorities able to give help, and not least, to the patient

Temporary accommodation in hospital

Many elderly invalids are cared for at home by relatives or friends From time to time a domestic crisis occurs, a daughter may be awaiting confinement, there may be illness in the family, or the younger members may be much in need of a holiday. If the elderly invalid can be admitted to hospital during these times it is a great boon to the relatives Many geriatric units reserve some beds during the summer months for temporary holiday accommodation.

This service is an example of the partnership envisaged by Sheldon (1954)

> " the two partners, private domestic life on the one hand and the services provided by the community on the other Between them they have to carry the total domestic burden of old age, including that of sickness "

CONCLUSION

The sulphonamides and the antibiotics have virtually revolutionized the treatment of the common infections in the elderly but technical cure alone is seldom sufficient when dealing with aged patients, environmental, economic and domestic factors have to be given equal attention Prolonged survival may in fact accentuate social difficulties These frequently prevent or delay the discharge of elderly patients from hospital although actual treatment has been completed

Hospital administration faced with the problem of ever increasing numbers of elderly patients accumulating in general hospitals turned to geriatric medicine for help and geriatric units have been established in many regions

This policy has given rise to considerable controversy, some members of the medical profession, basing criticism mainly on academic arguments, opposed the development of geriatric medicine In spite of this, over sixty geriatric units have now been established, a rapid and remarkable expansion within a few years

It is impossible to consider the modern hospital care of the elderly in terms other than those of the development of geriatric medicine

Even with an efficient geriatric service, many problems remain Waiting lists are long and still growing in some areas Hospitals complain that old people, no longer in need of hospital treatment, cannot be discharged because of lack of suitable alternative accommodation Local authority homes in certain districts have a large number of bedfast and ill old people who should be in hospital, but hospital beds cannot be found for them Both hospitals and local authorities are gravely perturbed about the increase in numbers of the infirm and frail aged

All these difficulties arise from one cause, the insufficiency of *total* accommodation, hospital, half-way and local authority "part III"

Old people prefer to live in their own homes and the expansion of home services will make this possible for many more Nevertheless, a time comes when, for many, constant care and help is required which cannot easily be given in private houses Few wish to spend their last years in a hospital Hostels can be good "substitute homes", hospitals cannot Therefore it would seem that the immediate need is for a great and rapid expansion of hostel accommodation including special provision for the very frail Only when this additional accommodation becomes available will it be possible to determine whether or not more hospital beds for the aged are required.

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CHAPTER 16

PROBLEMS IN THE HOME CARE OF THE ELDERLY

J. H. Sheldon

The home life of old people occupies a position of primary importance in the care of old age, for there is general agreement that it is in the interests both of the old people themselves and of the community that as many as possible should be enabled to spend their last years at home rather than in an institution. With the prospective rise in the proportion of old people in the population over the next twenty years, a failure to achieve this object could have the widest repercussions on society, since it might entail either a great increase in the provisions for institutional care, or a severe competition with the younger generation for the hospital accommodation actually available.

From the medical standpoint, the home care of the aged falls virtually entirely within the ambit of the general practitioner. He does not need to be told that, when the focus is transferred to the domestic sphere, the technical measures of treatment and rehabilitation, which inevitably loom so large in hospital, become only a part of a much wider social problem. The fundamental asset in their domiciliary care is that the old people are in their natural habitat, that in general they value their independence above almost all else, and are prepared to make the best of their physical disabilities in order to preserve it. It is not without significance that in the recent Sheffield survey the subjects tended to rate their own state of health better than did the examining physician, and in fact the number of old people who regarded themselves as fit was more than twice as large as those considered to be fit by the physician (Hobson and Pemberton, 1955). This is all to the good, and confirms the greater vigour and mental determination of those old people who can continue to live in their natural surroundings. It is not to be doubted that in the final sum, their own optimistic estimate of their health contributes to its maintenance. This is borne out by the astonishing retention of unrestricted mobility by old people living at home, which was found in both the Sheffield and Wolverhampton surveys (Hobson and Pemberton, 1955; Sheldon 1948). (*See* Table XXXIV.)

TABLE XXXIV

Mobility and Assessment of Fitness

Survey	*Unrestricted mobility (Per cent.)*	*Self assessment as fit (Per cent.)*	*Physician's assessment as fit (Per cent.)*
Sheffield (Men) - -	71.2	61.4	26.2
Wolverhampton (Men) -	70.0		35.4
Sheffield (Women) - -	54.9	48.7	23.0
Wolverhampton (Women) -	63.5		19.4

The assessment of the Sheffield subjects was made after a medical examination, that of the Wolverhampton subjects as the result of an interview only Not only is there a general concordance of the results, but in both surveys there is the most striking discrepancy between the percentage showing unrestricted mobility and the percentage assessed fit by the physician The Sheffield survey reveals, on the other hand a close approximation between the self-assessment of fitness and the capacity for free movement This is a fact of outstanding importance Not only does it confirm the statement already made as to the general vigour of old people living a natural life, but it would seem to have a further corollary If the object of geriatrics is to add life to years rather than
unwise to risk disturbing this desirable state
iatrogenic ill health that could result from a
examination

MEDICAL PROBLEMS OF OLD PEOPLE AT HOME

Apart from the cases with mental disturbance, the medical problems of old people at h [illegible] tive powers of movement
e only capable of limited
Table XXXV There are
ample, there is a greater
percentage of men confined to the home in Wolverhampton than in Sheffield whereas the reverse is true for women, which is yet another instance of the fascinating local variations which are of such importance in all studies of old age In both towns the incidence of ill health was greater age for age amongst women, which seems to be an invariable finding in old age The table illuminates the main aim of the domestic care of old people, that is, the importance of the retention of health in those whose capacity for free movement has begun to contract, without however reaching the ultimate stages of confinement to home or bed Those departures from health due to conditions already fully described in the text books of medicine will not be dealt with here, attention will be confined to the specific ailments of old age itself

TABLE XXXV

MEDICAL PROBLEMS OF OLD PEOPLE AT HOME

Survey	*Bedridden (Per cent)*	*Confined to house (Per cent)*	*Limited outdoor activity (Per cent)*
Sheffield (Men) - - - -	0 5	2 6	25 7
Wolverhampton (Men) - - -	2 8	7 0	18 2
Sheffield (Women) - - - -	1 8	12 4	30 9
Wolverhampton (Women) - -	2 4	9 0	24 0

Value and responsibility of the general practitioner

It is desirable to stress again that the home care of the aged would be impossible without the general practitioner, and that as well as placing a special responsibility

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beds for others whose medical needs may be greater From the point of view of the practitioner, the problem is usually that of obtaining admission to hospital There is often an inevitable delay, and during this period the practitioner may need to obtain help from the domestic, nursing, and home help services provided by the local authorities The difficulty here is the scarcity of home helps and competition with other needs for their assistance (such as maternity) and the pressure of other work on the District Nurses A method that may be used in cases of extreme difficulty is to make use of Section 47 of the National Assistance Act, 1948, in which a procedure is laid down whereby the court is empowered on a certificate of the Medical Officer of Health, to order the removal to hospital of persons who (a) Are suffering from grave chronic disease or, being aged, infirm, or physically incapacitated, are living in insanitary conditions, and (b) are unable to devote to themselves, and are not receiving from other persons, proper care and attention This method should only be used as a last resort and is in fact rarely used The health of persons living alone is liable to be prejudiced by loneliness and by the strain of domestic work, including the provision of adequate meals These people frequently need domestic assistance, as by home helps, visiting, and the provision of meals in order to prevent a total breakdown of health The semi isolates often present a bigger practical problem than the isolate, for in illness they have not the same *prima facie* claim for hospital accommodation, though the real need may be as great The essence of their problem is that both the old people, whether husband and wife, two sisters, two retired friends, have need of each other merely for the maintenance of independent domestic life Therefore, illness in one partner raises inevitable difficulties If the illness be so severe as to necessitate hospital treatment, the old person may be extremely reluctant to be moved, and if he is willing arrangements may be necessary for the remaining partner, which are always difficult Temporary admission to hospital is occasionally possible, or the Welfare Officer may be able to provide temporary accommodat...
if neither source of help is available then al...
need to be deployed A similar difficulty ari...
stands an excellent chance of relief by one ...
such as an orthopaedic operation for a defo...
it because of the home circumstances and...
cover during the absence in hospital even th... refusal of immediate treatment may accelerate the ultimate breakdown of the household A further difficulty which is apt to present the practitioner with special ...

... sought for both ... permanent

Nursing and domestic assistance from family

A second difficulty which often faces the practitioner is that of obtaining adequate nursing and domestic assistance from the family of the old person It is the fashion to suggest that family feeling is not what it was, but this is an unnecessary hypothesis for in the past the number of old people who laid an unconscionable burden on their children has always been much greater than those who could be accommodated in institutions, and the community undoubtedly took too much

on his shoulders, it provides him with opportunities for advancing our knowledge of the total natural history of the ageing process that are denied to those whose work is confined to an institution Not only is he in contact with fit old people and with those whose disabilities do not require institutional care or investigation, but he alone in the medical profession is in immediate contact with the whole social nexus of his patients To base far-reaching conclusions on those of the aged who are under institutional care suffers from the same defective focus as would a study of the natural history of the hippopotamus that was limited to those individuals which happened to be confined in zoos The responsibility of the general practitioner is not confined to the mere care of his older patients, he has here a field of research peculiarly his own, for by his contact with individuals throughout their life he has unique opportunities for those longitudinal studies of the ageing process, in which we are so lacking

Social factors influencing medical care at home

Isolates and semi-isolates

Three factors in the social background of older people are apt to influence their medical care at home The first is the problem of the isolate, the old person who lives entirely alone without effective human contacts with either relatives or friends There is an astonishing local variation in their incidence, but over the country as a whole it has been estimated that they form nearly one-fifth of the old-age population They are likely to increase, for one cause of the increased proportion of old people in the population is the fall in the birth rate over the last seventy years This means that there are fewer children available to help the old people, and indeed it has been estimated (Titmuss, 1955) that as much as 25 per cent of the old people at the present time are without children Attached to this group are the semi isolates, those old people living together in a state of infirmity which only allows them to maintain their independence by a united effort, which breaks down in the presence of illness in one These two categories, the isolates and the semi-isolates, tend to provide both the general practitioner and the community with their biggest problems in the care of old people

So far as the isolate is concerned, a frequent situation is that presented by the old person living alone who is not ill enough to need admission to hospital, but nevertheless requires supervision The attention of the practitioner is often called to these individuals either by neighbours or sometimes by the Welfare Officer, and they may then need routine visiting for social rather than medical reasons When they are actually ill and treatment is of a kind that can be carried out at home, a difficulty is apt to arise over the supply of drugs, for there is no one else in the house to check what they are doing, and their own memory and powers of attention may not be trustworthy Presented with a supply of tablets there may be an equal chance of their taking them all at once or not taking them at all, and wherever it is possible it is probably best to treat them by injection When the

the problem of their admis-
mmunity who are competing
ial importance in that their

admission to and retention in hospital is likely to be determined by social rather than by medical reasons, with inevitable repercussions on the availability of these

proportions of senile cataract were almost the same in both men and women indicates that occupational factors had not been of aetiological importance Cataract was a common and important cause of loss of vision Cases awaiting operation should be dealt with as quickly as possible as we have seen the marked

cause of loss of vision

Hearing

By the age of 80, two-thirds of old people of both sexes suffer from a decline in auditory acuity, due to the well known loss of hearing for high tones Most old people can obtain help from a hearing aid but in many cases they do not work them properly and then unnecessarily abandon them They should be encouraged to persist and to visit the special hearing aid centres again when advisable, for deafness of any degree often has unfortunate psychological effects causing many old people to retreat into an unnecessary social loneliness

Feet

The care of the feet of old people is a matter of the utmost importance, for painful feet are an unduly common reason for limitation of free movement, and the frequency of the complaint is a challenge to preventive medicine In the recent Sheffield survey painful feet ranked fourth in the list of reasons for disability (Hobson and Pemberton, 1955) There are two main types as follows

(1) *Neglected feet, with uncut nails various callosities and corns* —There is no doubt as to the boon that chiropody confers on these individuals, and endeavours should always be made to provide it for old people at home, when necessary It is however, not yet available as a service under the National Health Scheme, but in many places special arrangements are made for it either through the welfare services or the voluntary bodies There is, however, one aspect of unlimited chiropody which it is desirable to stress, it is by no means without danger in old people who are diabetics or who have advanced arterial disease in the extremities and in these cases it should only be used under strict medical supervision

(2) *Deformed feet* —These occur more frequently in women and are merely the carry over into old age of deformities which have been present in earlier years These people should be encouraged to seek orthopaedic advice, not only from the point of view of possible surgical help, but also as to the best type of shoe for their particular case Adequate feet derive an added importance from the liability of old people to tumble

Diet

One consolation of old age is that though other passions wane the enjoyment of taste persists and old people enjoy their food particularly the varieties they like as much as do younger people There is rarely need to interfere with the diet of old people at home but there are three types of case where it may be necessary

for granted the burden of sweated labour born in silence by these unfortunates Other social changes, particularly the greater mobility of the population, the scattering of families by new housing, and the growing employment of women in industry have tended to make it more difficult for the family and the good neighbour to make the contribution they used to The result is a greater call on the various domiciliary services, as well as for hospital treatment for conditions that in the old days would have been managed at home

Housing

A third difficulty is that of unsuitable housing All enquiries have shown that old people dislike leaving accommodation to which they have become accustomed over the years, and in consequence many of them are living in houses that are structurally unsuitable for the nursing of illness and are often unnecessarily inconvenient and laborious for efficient domestic service

IMPORTANT ASPECTS OF HEALTH

The first objective in the care of old people at home must lie in the preservation of their health and useful activity While the progress of the years entails a decline in the functional efficiency of the body for which at the moment nothing can be done, there are certain aspects of health, attention to which may bring considerable improvement in old person's vigour They are particularly important in that their neglect may affect the capacity to lead a useful life, with resultant effects on the individual s mental state The preservation of efficient sight and hearing and attention to the feet are among the more important of these

Vision

The vast majority of old people require to use spectacles for close work Prior to the introduction of the Health Service at least one-third were making use of glasses that were either ineffective or harmful Although there has since been an enormous improvement in this respect, there are still many old people who either do not know of the facilities that are available or are too conservative to make use of them It is of the utmost importance to urge them to provide themselves with adequate spectacles, for in old age visual information comes to have an increasing importance, and good sight may make all the difference to the capacity to lead a useful life Old people are more sensitive than the young to inadequate illumination, and it is often of importance to advise on the lighting of a residence, particularly in view of the liability of the aged to tumble Although at the moment a charge is made for spectacles, relief in cases of hardship should be sought from the National Assistance Board

Causes of failure of vision—In addition to presbyopia there are two other common causes of failure of vision in old age (1) Cataract, and (2) senile degeneration of the macula Hobson and Pemberton (1955) found in the Sheffield survey that the percentages of men and women suffering from senile cataract were 16·5 and 14 7 respectively Some of the men had been employed in occupations which involved frequent exposure to heat and infra red radiations The fact that the

its prevention Except where for other reasons it is impossible it is always advisable to let the old person out of bed to empty his bowels, and for this purpose a commode is very useful These are not always easy to obtain, but can sometimes be obtained on loan from the British Red Cross or the local Welfare Officer If it is essential for the old person to remain immobilized suppositories may be all that is needed or a preparation of senna It is worth remembering that many old people take Codeine in one form or another for the relief of various pains and that this can cause constipation which may easily produce faecal impaction in the presence of sudden immobilization A regular visit by the District Nurse with a periodic enema say once a fortnight may prove useful

Further dangers of prolonged immobilization lie in the well known complication of hypostatic congestion of the lungs in the fact that osteoporosis is an inevitable consequence of disuse of the bones and that there [illegible]
a variety
in bed
much as may be possible under the particular circumstances concerned The relatives often object to early mobilization In some cases this may be because it is much easier to manage an aged relative in bed than to have them moving about when their balance may be precarious and they cannot safely be left, but in other cases early mobilization is apt to be looked on as a heartless and unsympathetic procedure There are also special problems in the case of the semi isolate An aged and ailing wife may still be able to look after a husband confined in bed with say a cerebral accident but quite incapable of dealing with him in the early stages of *getting up* and about Although the avoidance of immobilization in bed is undoubtedly an excellent objective, its achievement in practice is rarely as easy in the home as it is in hospital

Mental vigour

There is probably no period in life in which physical vigour is more closely dependent on mental *vigour than old* age Fortunately the majority of old people who are able to maintain their accustomed habits of life do show such vigour but there are two common obstacles to serenity and mental health in old age

Loneliness

The first is loneliness and this should be regarded not so much a matter for sympathy as for effective help There is little doubt that loneliness in old people leads to a decline in physical vigour as well as in mental health and a vicious circle is apt to start in which each of these declines further There is much difficulty in the discovery of these unfortunates but the importance of their relief is well recognized and the National Old People s Welfare Committee regards the visiting of such individuals as among the more *important* of their tasks The worst loneliness is found when either Darby or Joan [illegible]

(1) Real malnutrition, in the sense of actual starvation or gross avitaminosis is rare, but minor degrees of both undoubtedly occur in old people, to a greater extent than is often realized The commonest defect is a qualitative one rather than a total defect of calories, and usually arises from the use of a diet requiring the minimum of effort in preparation, such as bread, margarine, jam and tea Such a diet is especially apt to be taken by the male isolate, by old people whose infirmity prevents adequate shopping or cooking, and by those who as a result of loneliness and depression have become indifferent to food Diagnosis is of the first importance in these cases, for the results of such a defective intake are often insidious and may be as much mental as physical, so that the real cause may not immediately be obvious Lassitude, depression, and mental apathy are as frequently the result as the cause of such under-nutrition, and other symptoms which should excite suspicion are loss of appetite and anaemia With such symptoms, the diatetic habits of old people living at home should always be enquired into, and measures taken to provide a more varied diet In many cases external assistance will be necessary

Where there is financial stringency the National Assistance Board may be able to provide a supplementary pension, and for others the provision of "meals on wheels", or introduction to a club where meals are available, may be useful Help in these cases should always be sought from the local Welfare Officer or the local branch of the National Old People's Welfare Committee,

(2) There is some evidence to suggest that old people have difficulty in digesting fat, and that calcium absorption in the aged is depressed in the presence of a high fat intake In view of both the frequency and importance of osteoporosis in old women, this may have a practical bearing, and in such cases it may be useful to counsel moderation over fat, and to ensure an adequate intake of protein

(3) Obesity in old age raises difficult problems There is no doubt that obesity is inimical to long life, and this is probably especially true of men Since dietary habits have usually become crystallized by the time old age is reached, treatment is difficult, and there is certainly no need to interfere with their enjoyment of life by an attempt to bring all old people down to some pre-determined ideal weight Where, however, it is producing symptoms particularly in the form of arthritis of the weight-bearing joints, hypertension, dyspnoea, or diabetes, then dieting along the usual lines for reduction of weight is indicated

Mobility

It has already been shown that one of the characteristics of old people living at home is their desire to keep up and going for as long as possible, and this is a habit to be encouraged Not only does a continuance in their accustomed routine help to maintain their mental poise but enforced immobility carries certain dangers It is apt to interfere with their bowel habits and lead to constipation The main danger here lies in the development of an unrecognized faecal impaction, which if not treated may proceed to actual faecal incontinence and is always the cause of much unnecessary misery to the old person Rectal examination should always be made when an old person confined to bed complains of constipation, and if faecal impaction be present it will need treatment by enemas and if necessary by manual removal, but far more important than treatment is

its prevention Except where for other reasons it is impossible, it is always advisable to let the old person out of bed to empty his bowels, and for this purpose a commode is very useful These are not always easy to obtain, but can sometimes be obtained on loan from the British Red Cross or the local Welfare Officer If it is essential for the old person to remain immobilized, suppositories may be all that is needed, or a preparation of senna It is worth remembering that many old people take Codeine in one form or another for the relief of various pains, and that this can cause constipation which may easily produce faecal impaction in the presence of sudden immobilization A regular visit by the District Nurse with a periodic enema, say once a fortnight, may prove useful

Further dangers of prolonged immobilization lie in the well known complication of hypostatic congestion of the lungs, in the fact that osteoporosis is an inevitable

much as may be possible under the particular circumstances concerned The relatives often object to early mobilization In some cases this may be because it is much easier to manage an aged relative in bed than to have them moving about when their balance may be precarious and they cannot safely be left, but in other cases early mobilization is apt to be looked on as a heartless and unsympathetic procedure There are also special problems in the case of the semi isolate An aged and ailing wife may still be able to look after a husband confined in bed with, say, a *cerebral* accident, but quite incapable of dealing with him in the early stages of getting up and about Although the avoidance of immobilization in bed is undoubtedly an excellent *objective*, its achievement in practice is rarely as easy in the home as it is in hospital

Mental vigour

There is probably no period in life in which physical vigour is more closely dependent on mental vigour than old age Fortunately the majority of old people who are able to maintain *their accustomed* habits of life do show such vigour, but there are two common obstacles to serenity and mental health in old age

Loneliness

The first is loneliness and this should be regarded not so much a matter for sympathy as for effective help There is little doubt that loneliness in old people leads to a decline in physical vigour as well as in mental health, and a vicious circle is apt to start in which each of these declines further There is much difficulty in the discovery of these unfortunates, but the importance of their relief is well recognized and the National Old People's Welfare Committee regards the visiting of such individuals as among the more important of their tasks The worst loneliness is found when either Darby or Joan is left completely alone after a life of companionship and when this has been so satisfactory that wide social contacts have not been made and the individual happens to be an introvert, the resulting state may be pitiful Where a practitioner knows of such a case, he can obtain help from the branch of this Committee

Old people's clubs —Loneliness can often be relieved by making use of the various forms of old people's clubs, and indeed there are an increasing number of old people themselves who are willing to help by regular visiting These old people's clubs are nation-wide in extent and are coming to play an increasing part in the life of old people and full use should be made of them by the practitioner Some old people are so anti-social that they are quite impervious to help, but in many it is the initial step that matters, and especially if they have been visited first by another old person an attendance at the club may result in a successful contact

Avoidance of boredom

The other factor derives from boredom and the sense of being useless There is no doubt that old people obtain an especial satisfaction from the knowledge that their existence is necessary to others, and with men especially, an enforced retirement at a certain age often brings much boredom and unhappiness which in turn may lead to physical deterioration The man who has cultivated an adequate hobby gains greatly thereby in his later years A rural community has a great advantage over an urban one in this respect, for the countryman can almost always find something to do in his declining years.

Experiments —Quite apart from the problem of the continued employment of older persons, there is undoubtedly need for experimentation in making available to the community the skill and experience of those who have retired but are still able and anxious to contribute to the total effort of the community Two may be mentioned—In this country there is the well-known experiment at Finsbury (Blyth Brooke, 1955) where the Medical Officer of Health has organized a centre in which older people are able to exercise manual skills In the U S A the remarkable experiment at St Louis known as Experience Inc should be mentioned as a pioneering venture of great interest Here a number of men who have retired from positions of administrative responsibility have formed a club which in addition to meeting for companionship, will provide a team of great and appropriate experience to advise on special problems in commerce or administration Its success suggests that the experiment has been of benefit both to the older men and to the community

Behaviour difficulties

Difficulties in behaviour are at times the cause of much social and domestic trouble Those based on a true senile dementia need institutional care, but there are many intermediate cases for which this would be wrong In all such a careful physical examination is necessary, for these behaviour abnormalities may be the result of vascular changes in the brain, at times of an unsuspected stroke, and are sometimes due to simpler causes such as malnutrition It is of especial importance to make the most careful appraisement of all old people with mental changes such as restlessness, confusion, loss of memory, or behavioural unpleasantness, since these throw a far bigger strain on the younger generation of the family than does physical defect Some of these are frankly insoluble except by the patience of the rest of the family So often old age brings an intensification of habits of thought and behaviour present in earlier years and one of the most frequent and the most difficult of these occurs in the man or woman who after a lifetime of

[illegible] passes at the end of life into an exacting selfishness which [illegible] met in the [illegible]

risk of falls and fractures, so [illegible] search for physical causes, it should be borne in mind that this state of affairs sometimes results from the use of barbiturates, for old people tolerate these drugs badly

Incontinence

One of the greatest strains imposed on the household by an old person with mental disturbance is incontinence This may, of course, have a physical basis, and full physical investigation is always necessary, but there are many cases in which the cause is mental It may arise as a feature of senile mental deterioration, but it sometimes has an emotional basis in a desire for attention and is apt to follow restriction to bed so that it is always advisable to try getting the patient up when the physical conditions allow

Depression

Another frequent affective disorder of old age is depression, which can throw a considerable strain on the patience of a household In all these cases, and particularly when depression is present treatment with Chlorpromazine (Largactil) is worth a trial It is too early to make a final assessment of its use, but there is no doubt of its value in the home care of many old people It should, however, be borne in mind that it potentiates many of the drugs used in the treatment of insomnia, and during its use they should if possible be avoided or given in smaller doses It also appears to be of use in relieving distress in a long and fatal illness, as in death from carcinoma One important development is the attendance of the severely depressed patient at the out patients department of a mental hospital for suitable therapy, this may obviate the need for admission into an over-crowded mental hospital

Conduct of personal affairs

One great difficulty that is apt to arise with old people whose mental powers are failing lies in the conduct of their affairs They may, for instance, be so completely careless over money that something has to be done, although they are not certifiable In such cases it is well to remember the existence of The Court of Protection (address 25 Store Street, London W C 1) which is empowered to supervise the affairs of such patients

DISABILITIES OF ADVANCED YEARS

In dealing with the actual diseased states of old people that raise problems in home treatment attention will be focussed on the main disabilities of advanced years that is those beyond the middle seventies The most important are of course the results of vascular disease, whether cardiac or cerebral arthritis of various kinds and respiratory disease These are already dealt with elsewhere and will

therefore not be given further attention here, and *it is more important to deal with* those aspects of altered function in late life which makes life so miserable for some individuals Women are concerned to a far greater extent than men, for one of the mysteries of old age lies in the fact that the lower mortality of women is accompanied by a higher morbidity rate

If one investigates the reasons for limitation of movement one finds a distinct difference between the two periods lying on either side of the middle seventies, and it is in the later period that the maladies specific for old age make their appearance, though carcinoma and the various local effects of vascular disease, joint disease, respiratory disease are of fundamental importance throughout the whole old-age period The disabilities to be described lead in sum to a considerable loss of happiness and efficiency in old people

Weakness

This symptom, which affects women much more frequently than men, becomes increasingly important after the age of 75 It is very difficult to characterize with precision, *for although at times it appears to be the expression of some deeper complaint* such as myocardial failure, at other times it undoubtedly exists by itself as a genuine senile phenomenon, and is a complaint that many old people find particularly distressing From the purely clinical point of view the accounts of the condition are reminiscent of myasthenia gravis, in that a movement performed with preliminary ease rapidly becomes tiring, but the condition has never been investigated from this point of view It is, however, almost certainly associated with the muscular wasting which begins in early middle age and steadily progresses thereafter Some old people seem to have a selective muscular wasting, which affects the small muscles of the hands, and is often quite striking in the glutei and quadriceps The condition is a common cause of the severe grade of loss of movement resulting in inability to leave the house It is an important underlying reason for "senile infirmity", and in practice it is often aggravated by unsuitable housing conditions There are many old people with this condition who find it impossible to live a satisfactory life in an old-fashioned house with stairs and inconveniently placed lavatories, who could manage quite well in a bungalow It is one of the physical aspects of senility which deserves full domiciliary assistance, since it is beyond the scope of therapeutics

Vertigo and dizziness

This is a frequent complaint in the aged A precise description is difficult since so much depends on what is meant by these words, and too much reliance cannot [illegible]

[illegible] used to describe a sense of insecurity and unsteadiness Either may exercise quite a disabling effect on the capacity for free movement Some cases are undoubtedly *caused* by disease of the ear with involvement of the labyrinth, many more are associated with arterial disease, hypertension, and postural hypotension, and every case demands a careful appraisement The majority appear to result from labyrinthine trouble or from central causes, particularly cerebral arteriosclerosis

Treatment

Treatment is difficult Some patients are helped by antihistamine preparations and some by suitable rehabilitation exercises, but it is most important to discover if there are any precipitating causes of the attacks, for it may then be possible to do something in the way of prevention A careful study by Orma (1955) has shown that the symptom frequently results from movement and from the adoption of certain positions Individuals with this complaint should be advised to refrain deliberately from all sudden movements, particularly turning the head or rising quickly from bed or a chair, and as walking is a frequent factor, to make use of a stick A common precipitating movement is that of throwing back the head and looking upwards, which inevitably occurs in many domestic operations In susceptible old people this movement almost invariably leads to severe giddiness and often to a fall, and it is always advisable to warn old people liable to vertigo against adopting this posture The prevention of dizziness is of great practical import in that it is one of the more promising lines of attack on the appalling problem of falls in old age

Fainting attacks

Allied to dizziness are the sudden episodes, often associated with and described as a faint, which appear to be syncopal in nature They have been well described by Nisbet (1955) as "wee turns" and her clinical description is a valuable one Several mechanisms appear to be concerned Some are undoubtedly vasovagal attacks others are due to postural hypotension, and Exton Smith (1955) is probably correct in attributing others to a hypersensitive carotid sinus reflex These fainting attacks are particularly common in cerebral arteriosclerosis They offer a very difficult problem in treatment and each case merits a full investigation by modern methods They are especially important in old people living alone, owing to the liability to injury

Osteoporosis

This is an inevitable feature of old age, particularly in women, for by the eighties probably 100 per cent of [illegible]
really a [illegible]
and a [illegible]
import [illegible] it may be the cause of much complaint of back pain
and in many of these cases [illegible]
of the condition in very [illegible]
in time to shortening an [illegible]
movement and a minor [illegible] a contusion of a [illegible]
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the [illegible]
old [illegible]
calc[illegible]
[illegible] in calcium metabolism,
and it may well be only a facet of the general wasting of [illegible]
which appears [illegible]

Treatment

In the treatment of a case, *it is well to enquire into the diet, and to ensure an* adequate intake of protein, and as calcium absorption in old people appears to be affected by the level of fat intake, to restrict this when necessary. It is probably wise to ensure an adequate intake of calcium, if necessary as calcium gluconate or as extra milk, and also vitamin D, but these are almost certainly not fundamental *The special incidence of the condition in women and its development* after the menopause suggests an endocrine origin, and in severe cases treatment by ovarian preparations should be tried A full account of the condition has been given in the recent Lumleian Lectures by Cooke (1955)

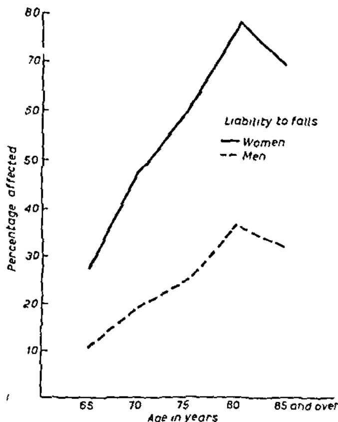


FIG 60—The incidence in men and women of liability to falls

Falls

The liability to tumble with subsequent injury is the major occupational risk of old age, particularly *among individuals living a free life at home* 90 *per cent* of the fatal falls occur after the age of 65, and 65 per cent of the fatal domestic accidents occur during this same period The individual runs the risk of death or of a serious breakdown and the pressure on hospital accommodation presents the community with serious problems which are likely to increase

Incidence

Fig 60 shows the incidence of the liability to tumble, as shown in the Wolverhampton Survey (Sheldon, 1948) It will be seen that women are more affected than

men, and that the proportion rises steadily up to the age of 80, by which time no less than 75 per cent of women are affected as compared with only half the number of men (37 5 per cent) It is sometimes stated that the larger incidence in women is only a reflection of their greater relative number at this age, but this is not the case Women are without doubt inherently more liable to fall than are men, but it is unknown whether this is due to a sex difference in ageing, or to their greater exposure to risk by virtue of their household activities

Mechanism

Analysis of a large number of falls shows that they can be divided into five groups (1) Associated with vertigo, (2) due to an increased liability to trip over trivial excrescences, (3) due to a momentary loss of balance which would rapidly be corrected in a younger person, (4) due to a posture placing a special strain on balance, and (5) those due to one or both legs suddenly "giving way" The mechanisms concerned may not be identical in these groups, but they can be divided into two classes, (a) with an internal origin, and (b) with an external origin

Internal causes —There is no doubt that the liability to vertigo which is a common symptom of age plays an important part in the falls of some individuals In the Wolverhampton survey 37 per cent of the men and 22 per cent of the women liable to fall attributed it to attacks of giddiness In the Sheffield survey, Droller, (1955) found that one third of those who complained of vertigo had experienced falls There is no doubt that more than one mechanism is included in the word 'vertigo Some are certainly attacks of true labyrinthine vertigo as they may be associated with deafness and tinnitus, while in others vertigo is really an expression of postural hypotension It is desirable to emphasize again the importance of making a diagnosis of the cause of giddiness whenever it is complained of by an old person While there may be little useful treatment for the old person with a true labyrinthine degeneration, the giddiness associated with movement or with a change of posture can often be prevented from hav [illegible] measures already outlined The o[illegible] is that when the individual sudd[illegible] gives way This fall only occurs [illegible] characters particularly tonelessness, which may make it impossible for the patient to help himself up again The cause is totally obscure, but would seem to depend on a failure of the central mechanisms subserving posture

External causes —These have two features in common, a liability to stumble and an increased difficulty in making in time the adjustments necessary to preserve balance Their increased liability to trip over minor domestic projections is well-known to many old people and is probably due in the main to the fact that their gait is one of short steps in which the foot is not lifted so high as in earl[illegible] An accessory factor especially [illegible] that they do not anticipate the a[illegible] a younger [illegible] peo[illegible] be [illegible] as a stone on a gravel path, it is probably not realized how many fatal accidents to old people occur in the garden [illegible]

Treatment

In the treatment of a case, it is well to enquire into the diet, and to ensure an adequate intake of protein, and as calcium absorption in old people appears to be affected by the level of fat intake, to restrict this when necessary It is probably wise to ensure an adequate intake of calcium, if necessary as calcium gluconate or as extra milk, and also vitamin D, but these are almost certainly not funda mental The special incidence of the condition in women and its development after the menopause suggests an endocrine origin, and in severe cases treatment by ovarian preparations should be tried A full account of the condition has been given in the recent Lumleian Lectures by Cooke (1955)

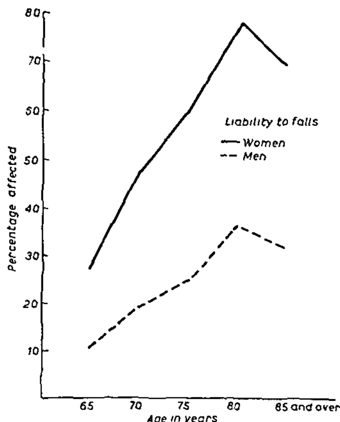


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This defect is, in many cases, probably a pure ageing phenomenon, but at times it undoubtedly has a pathological basis Incidents of minor cerebral thrombosis are often accompanied by a period when the liability to fall is greatly increased, and it is of interest that Droller (1955) found that in men an extensor plantar response was four times as frequent in men who fell as in the rest, and in women it was almost twice as frequent It should be emphasized, however, that no abnormalities can be found by examination of the central nervous system in many of the sufferers from falls

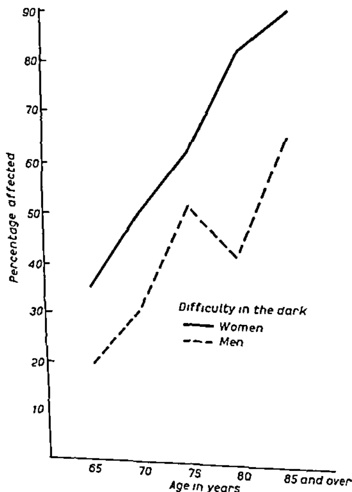


FIG 62.—Percentage of men and women who are affected by difficulty in the dark

Results

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or out of doors A younger person can unconsciously preserve balance by rapid powerful and accurate muscular adjustment which the older individual fails to make in time

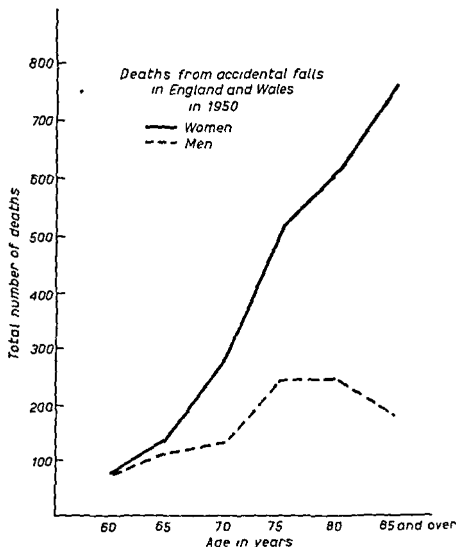


FIG 61 —Deaths due to falls as published in the Registrar General s returns for 1950

A further very important reason for domestic falls occurs when an old person places a special strain on his balance, as by throwing the head back, looking upwards and raising the arms above the head, as in cleaning windows, replacing electric light bulbs, and using a high shelf in a cupboard or larder Stooping is also an important factor All old people tend to describe these external types of tumble in the same way as "once you're going you ve got to go" This strongly suggests that one fundamental factor in their difficulty in preserving a balance which is under assault lies in a slowing down of the central mechanism in the brain, which under normal circumstances is able to transmit appropriate orders to the muscles in time for balance to be maintained

National Assistance Board

It is desirable at the outset to mention the National Assistance Board whose concern is the provision of supplementary grants and pensions when necessary Their officers, who are always most helpful, are in close touch with the needs of old age pensioners, and their existence should always be borne in mind This may be of special importance over such matters as the provision or repair of spectacles and where there is reason to suspect that an inadequate intake of food may be based on financial stringency Assistance may also be necessary over the purchase of new bedding in cases of prolonged illness

Home helps, district nurses and others

Numerous services are provided by the Local Authority, the two most important of which are the home helps and the district nurses The home help, whose function is the domestic one of housework and shopping, can render an immense service to the needs of old people at home, particularly in cases of infirmity or illness, and in addition there are many instances where her companionship during part of the day comes to be greatly valued by the old people The difficulty with home helps is that there are not enough of them, there are at present only 33,000 in the country as against the five million of old people The value of the work done by the district nurse in the management of illness in the house is too well known to need any stressing It has been well said that her characteritics are "reliability, daily availability, and easy accessibility" (Walsh, 1955), and indeed but for the district nurse there are many cases of illness in old people which it would otherwise be impossible to care for at home In many places the care of old people comes within the scope of two local Authority Departments, those of welfare and health, between which there is a close liaison In addition to home helps and district nurses, they can provide the services of health visitors, social workers, and occupational therapists The problem of residential accommodation often crops up in cases of prolonged illness in the home, sometimes as a permanent but often as a temporary measure to enable the younger generation to obtain a necessary holiday, and the welfare officer can often provide the necessary relief A further service which meets a tremendous need is that of the night attendant, which has been developed in some places By sitting up with the patient for one or two nights a week the members of the family are able to get a night's sleep and are then able to carry on for a lo

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be ... of their needs These derive from (1) The fact that the actual nursing of the final illness of many old people is done by another old person (usually the wife) and not the younger generation, (2) the duration of the illness which may be prolonged over a period of years and (3) the continuity of the task The resulting needs can often be solved by application to one or the other of the voluntary bodies interested in these matters

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or another by their falls is much larger than the number who actually die from them, but the figures demonstrate the practical importance of this aspect of the medicine of old age

Prevention

There is no therapeutic measure available to attack the problem at its source, the disturbance in the ability to preserve balance, but a lot can be done to prevent its practical expression The use of a stout rubber-shod stick is obligatory for any old person who is either subject to vertigo or has once had a tumble, and all loose mats and unnecessary excrescences on the floor of a house should be avoided The use of a good handrail for the stairs is well known, but this is usually most helpful if it is on both sides of the stairs, and special supports are usually necessary at the corners Also, with an adequate handrail many old persons can manage the stairs more safely by coming down backwards Both the bath and the lavatory should be provided with holds which will help the old person to sit down and to rise again, and to avoid unnecessary stooping power points should, if possible, be three feet up from the floor Another domestic factor of great importance lies in inadequate lighting One of the most characteristic features of ageing is a steadily increasing difficulty in the dark, which can be seen from Fig 62 taken from the Wolverhampton Survey (Sheldon, 1948) By the age of 80, no less than 83 per cent of women suffer from this complaint This is no mere matter of difficulty in visual adaptation, but goes much deeper, for Szafran (1955) has shown that old people use visual information to control muscular movement in a way that younger individuals find unnecessary He quotes a remark of a man of 84 "that the chief change noticed in his powers as he grew older was that he had to give direct visual attention to the performance of manual habits" He said "If I lift a glass of water I must now keep watch on it or the glass may slip from my hand A few years ago the hand itself would entirely take care of such a matter" This certainly applies to the maintenance of balance, and if deprived of visual control the postural mechanisms of many old people fail to function efficiently, and many domestic falls are due to this factor The common places liable to inadequate illumination are the lavatory, the stairs, and often the sink, and special attention is often advisable to these When old people have to get out of bed at night to urinate, a torch should always be available, and the old-fashioned night-light is still valuable in this situation, and incidentally, is often a help in old people liable to nocturnal confusion Adequate domestic illumination is of great importance

SERVICES AVAILABLE IN THE HOME

There are a surprising number of sources from which assistance may be obtained, but they are not always known as well as they should be, partly because of their very multiplicity and partly because there is no single organization concerned with old age This provides the practitioner with a special opportunity, for the ignorance of many old people in need of help as to what is actually available for them, is quite remarkable

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It might be thought that with all these services available, it would be an easy matter to nurse most of the aged sick at home, but this is not the case, largely because of the special features of their needs These derive from (1) The fact that the actual nursing of the final illness of many old people is done by another old person (usually the wife) and not the younger generation (2) the duration of the illness which may be prolonged over a period of years and (3) the continuity of the task The resulting needs can often be solved by application to one or the other of the voluntary bodies interested in these matters

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to such domestic ...
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provided by the National Health Service loans can sometimes be obtained from the Local Authority or the British Red Cross Society.

One of the major domestic difficulties that arises from the prolonged nursing of an old person at home is the burden of washing soiled bed-linen, and there is without doubt need for the establishment of a special laundry service This need arises almost to a categorical demand when the actual nursing of one old person is being carried out by another, whose strength is quite unequal to the additional burden imposed by heavy washing There is little doubt that the extra washing entailed is often the deciding factor that leads to the demand for institutional accommodation for an ailing old person

A meals service is often an immense boon Not only does it help to preserve the health of many old people too infirm to do their own shopping and cooking, but it is also of value in cases of illness where an old person has to be left alone in the house by day owing to the absence of the younger generation at work The "Meals on Wheels" provided by the Women's Voluntary Service meets this need

There are available also a number of domiciliary services from the hospital, for example domiciliary visiting by specialists These services are described in Chapter 15

Were there no co ordination between the different voluntary and official agencies interested in old people, the practitioner or the old person in need would indeed be in doubt as to the most likely source of help Fortunately there is excellent co-ordination, which has largely been achieved through the local committees of the National Old People's Welfare Committee, of which there are over a thousand in the country Both official and the voluntary agencies are represented on these committees, application to which will ensure that what help is actually available will be provided A short printed statement of the various services available in *any particular locality would probably be of great use to the general practitioner* as well as to the old people themselves

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CHAPTER 17

EMPLOYMENT, RETIREMENT AND HEALTH

WILLIAM HOBSON

functional, metabolic, immunological and personality characteristics peculiar to their age so do the aged In the case of children there is a fairly sharp dividing line between childhood and adolescence at the age of puberty, but there is no sudden change in ageing, the process is a gradual one

From the official point of view, old age is taken to be the age at which contributory pensions are first payable, that is, sixty in the case of women and sixty five in the case of men But the onset of physiological old age is not synonymous with any chronological age, it varies a great deal from individual to individual, due to the many variables in mode of living, accidents, the results of disease, and hereditary factors

FUNCTIONAL CHANGES IN THE ELDERLY

Age changes in cells

Age changes in cells have been studied most carefully in the long lived highly differentiated cells for example nerve, cardiac and skeletal muscle cells There is no uniform constant pattern in these changes but in general there tends to be cellular atrophy fatty infiltration and increased pigmentation There is an increase in connective tissue and a decrease in tissue elasticity, particularly in the skin

partly due to a general decrease in the blood supply of tissues resulting from generalized arteriosclerotic changes

Homeostatic mechanisms

There is also an inefficiency of the homeostatic mechanisms which maintain the constancy of the physico-chemical equilibrium thus, there is a great vulnerability to changes in temperature and metabolic and vasomotor responses are less effective There is less efficiency in coping with sugar changes (Smith and Shock, 1949)

(a)



(b)

FIG. (3.—(a) Calcification of arch of aorta (b) calcification of descending aorta



FIG 64 —Calcification of thyroid

FIG 65 —Calcification of pleura



(a)



(b)

FIG. 63.—(a) Calcification of arch of aorta (b) calcification of descending aorta

Examples of these are arthritis and defects of the feet both very common (see ... and arthritis for example limits greatly the skilled work that ... or to ... ppling deformities for a labourer The tendency ... linger when falls occur



FIG 66 —Onychogryphosis varicose dermatitis hallux valgus and pes planus

Special senses

Changes in the special senses are very importan...

... tests Deafness especially for the higher tones ... severe than is revealed by the increasing with age and more common in men There is some evidence that this may be due to acoustic trauma in industry (Hobson and Pemberton ... Vertigo on the other hand is more ... with arteriosclerosis of the lab...

whilst many elderly people fail to respond to an injection of insulin by a fall in blood sugar (Himsworth and Kerr, 1939) Small variations in temperature and pulse have a much greater significance in the elderly There appears to be a wide range in the resting pulse rate, and in a person with a normal resting pulse of 50 to 60 a pulse rate of 74 may represent a considerable degree of tachycardia Symptoms and signs are less conspicuous than in younger patients and minor deviations take on a greater significance Repair is much slower and there is a narrower margin of safety, thus anaemia is much more detrimental to the arteriosclerotic person

Blood pressure

The rise in blood pressure with advancing age is well known, but it is much more difficult to say when this becomes pathological It is clear that many old people can remain perfectly healthy with a raised blood pressure Hobson and Pemberton (1955) found, for example, that in a random sample of old people living at home, 43 per cent had a resting diastolic blood pressure of 100 millimetres of mercury or over and the majority of these were in good health

Central nervous system

In the central nervous system there are a number of changes which, if they had occurred in a younger person would be of clinical significance, but appear to be of little importance in the elderly Thus, loss of vibration sense, brisk knee jerks, muscular weakness and wasting, pupils which do not react to light, can all occur in the absence of any evidence of organic disease Similarly, there are certain mental changes which are characteristic of old age, such as impaired memory for recent events, which may make it difficult to take an accurate history Apathy and depression have important effects on behaviour

Achlorhydria; atrophic gastritis; dyspepsia; constipation; deficiency diseases

There can be little doubt that an adequate well-balanced diet is an important factor in preserving the health of the elderly Mental factors characteristic of the elderly such as apathy and forgetfulness may adversely influence health by leading to a monotonous and inadequate diet In addition, atrophic changes occur in the digestive tract which can have marked effects upon the absorption of nutrients for instance, achlorhydria is present in 35 per cent of elderly people over the age of sixty years (Bloomfield and Polland 1933), and the concentration of pepsin and also tryptic activity fall off markedly in later life (Meyer, Spier and Neuwelt, 1940) Recent surveys have established the high incidence of chronic atrophic gastritis over the age of fifty years It is well known that dyspepsia and constipation are common These various factors are no doubt responsible for some of the wasting or malnutrition that occurs in old age, or, in severe cases, for deficiency diseases such as scurvy and anaemia

Skeletal system

Changes in the skeletal system can have an enormous effect upon a person's physical capacity although they might be quite unimportant as a danger to life

PHYSICAL CAPACITY

The amount of physical work that can be performed by the elderly person has been studied extensively in the laboratory These studies, however, are full of snags and do not necessarily apply to conditions as found in occupational situations It is well known that after maturity, the speed reaction time and the strength of skeletal neuromuscular mechanisms are decreased In moderately hard physical work there is very little decrease in the mechanical efficiency in older persons, apart from those over seventy years of age In severe work, however, there is a marked diminution in this ability with age The chief physiological factor limiting performance appears to be the inability to supply the increasing amounts of oxygen required by the tissues (Robinson, 1939)

There is a definite deterioration in the speed of performance in the higher age-groups, the changes in women take place sooner and are more marked There is a similar decrease in dexterity Older men who have had mechanical training appear to be able to maintain the speed rates of young adults (Miles, 1954) This lends experimental proof to the well known observation that experience and practice can counteract the increasing disabilities of old age Smith (1938) made a study of men of different age groups working under conditions similar to those found in factories and he confirmed the observations of Robinson that in short periods, or with moderate work, the performance of the elderly was comparable to those of the younger age-groups When, however, the conditions became arduous, there was a definite decrease in the ability to perform high-speed manual work In all age-groups, however, there are great variations in individual ability, so that some of the older workers were able to better the performance of some of the younger workers This is an important consideration and emphasizes the principle that individual differences should be taken into account whenever the capacity of elderly persons is being considered

Accident proneness

Especially important in old persons is accident proneness De Silva (1938) found that many of the components involved in the driving of a car showed a steady deterioration over the age of thirty years but the mileage driven per fatality showed an improvement w[illegible]
years Vernon, Bedford anc[illegible]
rate in coal miners, showe[illegible]
and that increasing care anc[illegible] counteract the decreasing performance which might be predicted on the basis of physiological factors alone The data for absenteeism are of interest in this respect but the results as one would expect are conflicting since they are biassed by the fact that only those able to maintain good attendance records remain employed

Need for further research

There is a great need for further research in this field and we require more information on the actual occupational capacity of different age-groups The selective process which weeds out the more unfit with increasing age, complicates

falls and fractures, and is an important cause of impaired mobility (Droller and Pemberton, 1953)

THE MEANING OF NORMAL IN RELATION TO AGE

A good illustration of the concept of normality and age is afforded by estimations on the power of accommodation of the lens If the accommodation of the lens measured in diopters is plotted against the age in a large number of healthy individuals, the values all fall within two smooth curves which enclose the normal range for accommodation and thereby set up the standards of normality at the different age groups (Fig 67) The power of accommodation falls steadily with age

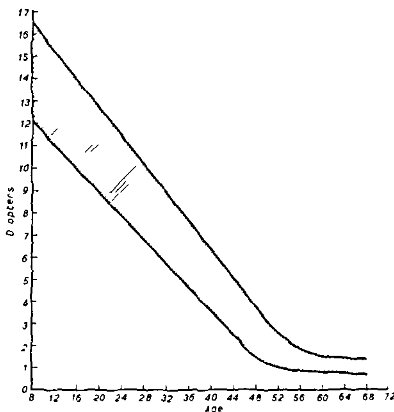


FIG 67 —Range of accommodation in relation to age

until the age of fifty years when it remains stationary We can say, with a fair degree of accuracy, that in the great majority of people physiological senescence in the human lens is reached at the age of fifty years, but it begins at quite an early age, even before puberty

Until recent years, we have had little information on the normal ranges of many of the biochemical variables, and even the values for younger age-groups are often based on inadequate figures These are dealt with by Dr Jordan in Chapter 3 It is important that these changes should be taken into consideration in diagnosing disease

the person is interested On such tests as vocabulary and general information older adults achieve as well as younger subjects Changes of performance with age appear to be small in some cases, at least among those who are better educated This may be due to education itself or to higher intellectual capacity There are some suggestions that in the course of education at a university level, people acquire certain intellectual skills which do not desert them (Owens, 1953) A special intelligence test administered at the time of college entrance and administered again thirty years later showed that scores are on the whole higher on the re test

It would appear that although many age changes are continuous in nature, their effects are not necessarily so A certain minimum capacity is required for performance of any kind and so long as the age changes are not sufficient to bring mental or phys cal capacit belo that

TABLE XXXVI

RESTRICTION OF MOBILITY BY AGE

(*Prof Hobson and Dr Pemberton* 1955)

	Age in years				
	60–	65–	70–	75+	Total
Males at risk	—	38	80	73	191
Percentage unrestricted activity	—	81 6	78 8	57 5	71 2
Percentage restricted outdoor activity	—	15 8	21 2	35 6	25 7
Percentage housefast or bedridden	—	2 6	—	6 9	3 1
Females at risk	43	105	74	60	282
Percentage unrestricted activity	76 7	64 8	43 3	36 3	54 9
Percentage restricted outdoor activity	16 3	23 8	40 5	41 7	30 9
Percentage housefast or bedridden	7 0	11 4	16 2	21 7	14 2

CHRONIC SICKNESS IN OLD AGE

So far most of the changes in mental and physical capacity which have been described are what one might term physiological, but in the elderly there is a great deal of chronic sickness which the subject must suffer for the rest of his l fe In some cases with the aid of h s ph

we

paired vision It would appear that a high percentage at least one third of all old people suffer from impaired physical capacity as a result of chronic disease

studies in this field and indicates a need for longitudinal follow-up studies of groups of individuals in younger age groups

INTELLECTUAL CHANGES WITH AGE

A considerable amount of work has been carried out on the relation between intelligence and age and similar changes are found to those noted in sensory and motor efficiency, particularly where speed is concerned This decrease in the score achieved in the intelligence test takes place near the age of fifty years Again there are wide individual differences in every age-group In Fig 68 the smoothed curves indicating the decrease with age in intelligence test scores take the form of a parabola with a rapid rise up to the age of fifteen years, reaching a peak about the age of twenty years, and a gradual fall after the age of fifty years, with a more rapid decline after the age of seventy years

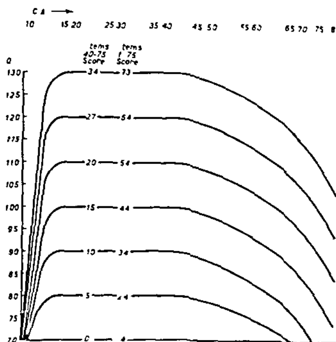


FIG 68 —Smoothed curves indicating the influence of age on intelligence test scores of older adults

The ability to learn depends largely upon the intelligence, so that memory function, ability to learn new tasks and tasks involving the relinquishing of old habits are found to be more difficult for old people Welford (1951) has carried out some experiments of a rather different kind These involved tests of logical thinking in a group of subjects engaged on university teaching and research The experiments, although not conclusive, showed that the older subjects tended not to draw logical conclusions based strictly on the statements given but often confined themselves to general remarks upon the statements In the older learner, interest in the subject aids the mental organization necessary for attention and retention Whereas in the younger person, active, varied learning is the rule, the older person's learning is concentrated more on some particular field in which

TABLE XXXVII

REASONS FOR PREMATURE RETIREMENT

Case No	Age in years	Job	Age at retirement	Reason for retirement
325	76	Farmer	50	Second wife well to-do
148	76	Brass turner	56	Became unemployed in the slump in 1930, could not find work again
150	76	Transport worker	48	Incapacitated at the age of 48 years by injury to right shoulder followed by osteoarthritis Only £130 compensation Probably compensation neurosis
115	73	General labourer	45	Epilepsy Afraid to go to town
119	74	Street hawker	54	Congenital subluxation of right hip
183	77	Time-keeper	50	Vague illness, not willing to discuss reasons
1	69	Elementary school teacher	53	Pneumonia and "breakdown"
18	68	Shoemaker	50	Duodenal ulcer Unwilling to work
26	69	Collier	43	"Put out of the pit because of deafness", and never got another job
48	72	Rating officer	50	Not clear Much part time activity, for example, president of the local W E A and keen amateur anthropologist
57	70	Moulder	55	Severe asthma emphysema and bronchitis
64	71	Maintenance fitter	54	Obsessional neurosis (the man who took engines to pieces after assembling them)
82	72	Police sergeant	49	Very good health No reason given

There were 14 (9 3 per cent) who had retired before the age of 60 years The reasons for retirement of these 14 men are of some interest In 13 of the 14 some information was available

Disabling physical illness alone accounted for 3 cases—congenital subluxation of hip, emphysema with asthma, and epilepsy, physical illness plus a psychological factor accounted for 5 cases, the economic depression accounted for 1, mental illness (obsessional neurosis) accounted for 1, coming into money 1, in 2 cases it was not clear although in 1 of these the desire to undertake voluntary work seem- have pla[illegible]
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OLD AGE AND ACHIEVEMENT

There are many instances of men who have achieved their greatest intellectual work after the age of sixty years Both William Osler and Harvey Cushing had to retire at the age of sixty years from their respective posts only to continue their great work for many years after in more enlightened institutions Oliver Wendell Holmes wrote his *Over the Teacups* at eighty years of age, Sophocles was the same age when he wrote *Oedipus* and Titian, Goethe, Benjamin Franklin, Voltaire, John Dewey, Churchill and many others have produced much of their best work in later life In the scientific field, however, much of the best fundamental research appears to have been carried out by younger men, although no doubt there are exceptions to this rule

AGE AND RETIREMENT

The evidence would seem to lend no support to the idea of fixing sixty-five years of age for retirement from employment rather than, say, seventy In view of the wide variations in abilities found in the older age-groups it might be thought desirable to have some means of discrimination by psychological tests at the age of sixty-five years, although this might well be considered undesirable on other grounds There are certain physical conditions which would disqualify a person from continuing work after the age of sixty-five years, for example severe angina, a previous stroke or failure of vision A medical examination might provide a gentle method of sorting out the wheat from the chaff It is important to remember that those with the best educational and cultural background show the least change with age and any diminution in the powers of critical reasoning may be more than compensated by the knowledge and wisdom gained as the result of experience

One thing is certain, and that is that there is a great need for more refined tests which will measure intellectual capacity in the aged The present tests do not measure many of the higher mental abilities and tend to discriminate against the elderly, particularly where speed is a factor They take no account of difficulties due to physical disabilities, for example deafness, tinnitus, defects of vision, tremor, weakness

Ill-health is, of course, a common cause of retirement amongst the elderly, the findings of Hobson and Pemberton (1955) suggest, however, that there is not such a close relationship between retirement and disability as might be expected There was little difference in health as measured by the disability scoring system in those working and not working at a given age

Of the 143 who had retired, 36 per cent gave ill-health as the reason, 24 per cent said that it was because they had reached an age limit, and the remaining 40 per cent gave various other reasons Thirteen per cent of all those who had retired were seeking work but were unable to obtain it It is noteworthy that only about one-third of those who had retired had done so on account of ill-health These findings, although the numbers are small, confirm the view that there is a substantial number of men over the age of 65 years who would and could continue at work if they were enabled to do so

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TABLE XXXVIII

MEN STILL IN FULL-TIME EMPLOYMENT

Age in years	Case No	Present occupation	Social class	Old occupation if different	Social class
67–69	10	Steel temperer	3		
	4	Tool firm director	2		
(13 out of 39)	9	Painter and decorator	3		
33 3 per cent	6	Steel firm director	2		
	19	Miller	3		
	20	Steel sawyer	3		
	2	Cutlery director	2		
	7	Commercial traveller	2		
	39	Furnace labourer	5		
	23	General labourer	5	Boot repairer	3
	31	Publican	2	Foundry worker	4
	34	Concrete mixer	4		
	35	Machine minder	4		
70–74	55	Furnace bricklayer	3		
	59	Furnace labourer	5	Hewer of coal	3
(18 out of 80)	62	Chauffeur	3		
22 5 per cent	68	Wire polisher	3		
	69	General labourer	5		
	73	Labourer	4	Chauffeur	3
	103	Drayman	4		
	72	Labourer	4		
	106	Turner	4		
	40	Hardware retailer	2		
	78	Labourer	4	Boilermaker	3
	81	Silversmith	3		
	52	Publisher's agent	2		
	66	Driller and borer	3		
	87	Labourer	4	Forgeworker	3
	101	Gold wire drawer	3		
	88	Fitter	3		
	93	Labourer	4	Coal carter	3
75+	121	Steel firm director	2		
	124	Manufacturer	2		
(9 out of 73)	149	Blacksmith	3		
12 3 per cent	152	Gardener	3		
	157	Labourer	5	Pipe coverer	3
	177	Sweeper	5	Furniture remover	4
	132	Commercial traveller	2		
	191	Wire rope maker	4		
	135	Auctioneer	1		

EMPLOYMENT OF OLDER WORKERS

In the light industries there is plenty of scope for placing older men and women in suitable jobs. One old lady has worked for a Sheffield firm for sixty-seven years, she refuses to sit down at her work and is doing a useful job. Recently the managing director told her that she must come at nine in the morning instead of at eight. This seemed to work all right and several weeks later the managing director asked the clerk if she was in fact clocking in at 9 a.m. "Oh, yes, she's clocking in at 9 a.m.

all right", said the clerk, "but she still comes at 8 a m". Another old man, eighty-one years of age still continues his work as a commercial traveller and goes to dances three times a week His chief worry seems to be due to the fact that he is being chased by a gay young *thing of fifty-two* with a view to matrimony Others say that sooner than retire they would prefer to continue working without pay *In the cutlery and silversmith* trades there are craftsmen of over eighty years of age who will be virtually irreplaceable when they retire The position in the heavy industries and particularly in unskilled work, however, is more difficult One Sheffield tool f

fellow workers They are particularly sensitive about the disparaging remarks of the younger men This is a most important factor in making them retire *It is probably* better to try and employ them wherever possible within the same factory We have alread

b

work such as the drawing of gold wire on the one hand, to the heavy work of building and dismantling furnaces, or working at the coal face on the other The highest and lowest social groups were over-represented amongst those still working whole-time compared with the social class distribution in the whole sample

This appears to confirm the findings of Welford (1951) that the elderly are less able to carry out work demanding speed They tend to pass out of skilled piece-work and become general labourers This description does not necessarily connote heavy work but often means such jobs as oiling and greasing, cleaning up, and *fetching and carrying tools which are well within the powers of many working* men after the normal age of retirement Most of those in social classes 1 and 2 who were still working were self-employed, and by virtue of *their position* were able to adjust their working hours to their capacity

TABLE XXXIX

REPRESENTATION OF SOCIAL CLASSES AMONG THOSE WORKING WHOLE TIME

	Social class		
	1 *and* 2	3	4 *and* 5
Whole sample (192)	19 3 per cent	57 8 per cent	22 9 per cent
Still working (40)	27 5 per cent	32 5 per cent	40 0 per cent

This is probably the reason why social classes 1 and 2 are disproportionately well represented It will be seen from Table XXXVIII that of the nine men who no longer worked at their chief lifetime occupation, all but one had moved to a lower occupational group The exception was a foundry worker who became a publican

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	35	Machine minder	4		
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	103	Drayman	4		
	72	Labourer	4		
	106	Turner	4		
	40	Hardware retailer	2		
	78	Labourer	4	Boilermaker	3
	81	Silversmith	3		
	52	Publisher's agent	2		
	86	Driller and borer	3		
	87	Labourer	4	Forgeworker	3
	101	Gold wire drawer	3		
	88	*Fitter*	3		
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75+	121	Steel firm director	2		
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all ages We have already seen how the disparaging remarks of younger workers are a frequent cause of retirement It is only by a suitable programme of education that the younger worker can be made to understand the problems of their older associates, and to realize that they in turn will meet with the same problems Moreover, preparation for old age is a life long undertaking and not something to be considered when the retirement age is reached The factory stands to the adult as the school does to the child in this respect The firm of Rubery Owen at Darlaston near Wolverhampton have started an experiment in the employment of elderly workers The firm provides a special shop where they can carry out joinery and light assembly work Two American cities, Chicago and Minneapolis have under consideration plans to provide pre retirement counselling as a central service available to workers in industry In a number of communities courses in preparation for retirement are being given as a part of the adult education classes or in evening classes of universities

Financial aspect

There is [illegible]

[illegible] up to £2 a week without reduction in pension Their pension will not be payable until they retire or reach the age of seventy years Details are given on page 5 of the *Report of the Committee on the Economic and Financial Problems* [illegible]

it wil [illegible]

ways [illegible]

ment [illegible]

(a) The limiting of compulsory entry up to a specified age, say, 50 with voluntary entry applying thereafter subject to satisfactory evidence of health or

(b) retention of the compulsory provision all through but with the introduction of a later pension age for those entering the scheme at an advanced age in order to make the pension as large as possible and the cost as small as possible, or

(c) to regard all persons entering after a fixed age say 50 as temporary staff and therefore ineligible to enter the scheme except by special agreement of all parties

There is no doubt that these financial aspects [illegible]

[illegible]

idea that [illegible]

irrespective of age [illegible] opportunity to give effective service [illegible] The keeping on of older workers causes delay in promotion

Individual cases

The following notes illustrate some of the circumstances under which work was continued by elderly men

An ex-boot repairer, aged 68 years, who has now become a general labourer He is depressed and feels he will be discharged soon, or that he will have to retire because of disparaging remarks passed by the younger workers

Steel wire polisher, aged 71 years In spite of angina of effort, he works a 68-hour week

A drayman, aged 70 years, was an example of how, if a physical disability can be removed, working capacity may return His wife said he was morose and apathetic before his cataract operation Since that was successful, he has been full of energy and zest and has gone back to full-time work again

A director of a steel firm, aged 75 years, a fit old man, whose only complaint was that his memory is no longer good enough to keep him in his administrative job Speech slow, but judgement good

An auctioneer, aged 83 years, a widower A lonely old man who still goes to an office in town but does not do any business

A sweeper and cleaner in a steel works aged 77 years Says he is extremely fit He is agile and finds his light job well within his capacity

A wire rope maker, aged 81 years "He refuses to retire because his whole life is bound up with his craft"

A commercial traveller in the wholesale food trade, aged 81 years, a widower Works full-time Cooks for himself or has his meals out Goes dancing two or three times a week Has not seen a doctor since he was aged 21 years

Industrial medicine

Industrial medicine has an important part to play in achieving these results and has two major functions The first is diagnostic, the management requires information on the type of work which the individual can do and requires to know when the change of occupation is to be desired The second function is a therapeutic one, the periodic health examination should help men to overcome their physical and mental differences Sound advice and counselling can do a great deal to overcome many of these disabilities The examination should be carried out by the works medical officer who understands *the conditions prevailing in the factory* There should be a full clinical examination including an electrocardiograph and x-ray of the chest There should be a re-examination once a year if possible

Pre-retirement counselling

All this is particularly important in view of the widespread individual differences between individuals *Some of these principles have already been applied in the* United States of America The Dodge, Chrysler and Ford Works all have schemes for the employment of their elderly workers The Standard Oil Company at New Jersey has what is called a *pre-retirement counselling programme*, where employees are interviewed five years before retirement is due to enable them to continue in a suitable occupation, should they so desire One of the most important functions of industry in this respect is educational *This should be directed towards workers of*

Meyer, J, Spier, E., and Neuwelt, F (1940) *Arch intern Med*, 65, 171

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and it may also close entrance to an apprenticeship where the age limits are fixed The National Advisory Committee on the Employment of Older Men and Women was set up to advise on the problem It issued its first report in 1953, this was known generally as the Watkinson report

Although prior to the war the percentage of elderly workers in whole-time employment was falling, it would appear that this trend has now been halted, at any rate in 1954 there were employed in this country, 870,000 men and women over pensionable age and 230,000 over the age of seventy years Fleming (1955) in a survey of the age composition of the iron and steel industry has shown that there are considerable differences in the age structure of firms carrying out similar work, some firms making fuller use of older manpower than others In the words of Fleming what is required is, " an approach which includes one or several of such industrial procedures as a periodic medical check-up of such persons, job analysis and work study applied in this connection, inter-age counselling or retraining, or definite and deliberate fitting of jobs to men " One thing is certain, it is quite impossible to make but the very broadest generalization in regard to employment Industry is so very diverse and individuals, as we have seen, vary so much in their capabilities and destinies

The problem has also concerned the non industrial worker The retiring age for professors at Edinburgh University is seventy years, whilst Cambridge and Oxford Universities recently raised the retiring age to sixty-seven years In an institution for higher education in New York City, ten professors with a total age of 706 years have been brought out of retirement in order to undertake teaching It is to be noted that in many occupations, for example Members of Parliament, clergymen, craftsmen, and in private practice in the professions, the date of retirement is in many cases well over seventy years of age

In old age physical vigour and muscular strength decline, but judgement and skill can remain, visual acuity diminished but the ability to comprehend what is seen may improve Men can be useful and productive members of society long after the age of seventy years They are at their best when enthusiasm and experience are evenly balanced and should have the opportunity of carrying on in a job more suited to their capabilities should they so desire There are many examples of old men who rapidly deteriorate when they retire unless they are fortunate enough to have developed some interesting and absorbing hobby Most people are unhappy when they are idle and this is particularly true of older people Perhaps one of the reasons why old ladies last so much longer than old men is that they never retire

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